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VOLUME XVIII.—SECOND SERIES.

London: 4/6

PRINTED FOR THE PROPRIETORS;
AND SOLD BY W. H. WYATT, AT THE
REPERTORY AND PATENT OFFICE, 9, PICKETT-STREET,
TEMPLE-BAR.

1811.

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v.13

JOHN NICHOLS and SON,
PRINTERS,
Red Lion Passage, Fleet Street, London.

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AGRICULTURE.

No. CIII. SECOND SERIES. Dec. 1810.

Specification of the Patent granted to JONATHAN VARTY, *of Liverpool, in the County of Lancaster, Coach-maker; for certain Improvements in the Axle-trees of Carriages.*

Dated September 17, 1810.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Jonathan Varty do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is fully described and ascertained as follows; that is to say: In making the arm of the axle-tree, I divide the bottom half of the axle-tree into several parts, according to the weight intended to be carried. I then cut out of the two upper thirds, supposing the under half to be divided into three parts, sufficient to take the bearing of those parts, so that the friction and weight rest only on the sixth part of the axle-tree. The bearing part I leave larger or smaller, agreeably to the weight intended to be carried.

In some cases I fix small rollers, two or more, as occasion may require, in recesses cut for that purpose in the bottom of the axle-tree. These rollers turn on their own axes in pieces of steel, or any other hard metal, also fixed in the said recesses. In this case the bottom of the axle-tree must be flattened, in order to throw the weight on the rollers. I then make a groove the length of the arm on the top-side, with small holes through the axle-tree to admit of oil flowing through to supply the axes of the rollers with sufficient moisture. In this case the box or bush must be made with a cap at the point or shoulder, or with caps both at the point and shoulder, to contain oil, as is frequently practised on different principles: or I supply the axle-tree with oil through a pipe, introduced through the shoulder-washer; at the upper end of which pipe I screw a can, cap, or hollow ball, to contain oil.

These several improvements may be used either separately or collectively. In cases where the box or bush is a fixture, instead of cutting away the axle-tree, I make the alteration in the bottom half of the box in the same way as described for the axle-tree. When horizontal axle-trees are used, the arm of the axle-tree should be of the same size at the point as at the shoulder, and the wheel made perfectly upright, without any dish.

In witness whereof, &c.

Specification of the Patent granted to JOSEPH WARREN REVERE, *of Boston, in the United States of America, residing at the London Coffee-House, Ludgate-hill, in the City of London; for a new and improved Method of splitting Hides and shaving Leather. Communicated to him by a certain Foreigner.* Dated June 19, 1810.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Joseph Warren Revere do hereby declare that the said invention is described and ascertained in and by the drawings hereunto annexed, and the following description thereof; that is to say:

Fig. 1, (Plate I.) the letters A A denote two cylinders of metal, or of any other firm and hard materials, fluted or grooved longitudinally upon the surface of both of them, and connected by wheel-work, so as to move together by means of a winch, or any other first mover. B B denote screws for setting the two cylinders at the proper distance from each other, and at each end of the upper cylinder there is a spring C, which, by its re-action, causes the said cylinder to recede from the other when the screws B B are turned back. D represents the hinder part of a metallic frame, in which is firmly secured, by screws or other suitable fastenings, a straight-edged knife, as seen in H, Fig. 2, which, when in its place, can be brought and applied so that the heads thereof shall lie or be disposed in the angular space between the two cylinders A A, having the said edge parallel to the axis of the said cylinder, and so disposed as to produce the effect of slitting hereinafter described. And in order that the due placing of the said edge may be correctly and adequately performed, the said frame D, which is more clearly and separately designated in Fig. 2, is made with parallel sides I K, so as to fit between grooves or supports upon or between the uprights E of the principal frame in Fig. 1. And the said grooves or supports are provided with suitable adjustments by screws or wedges, or other well-known means, by which the said frame can be so placed and duly fixed and secured. L and M, Fig. 2, denote two inclined or curved pieces of metal, or other fit material, proceeding from each side of the flat surface of the knife, and diverging therefrom so as to cause the parts of the hide or leather to separate, and be duly carried off after cutting. G is a roller, which I call a feeding roller, and which revolves on its axis in front of and parallel to the forcing cylinders A A. F F represent the framing or bed by which the machine is supported.

And I do hereby declare, that the method of working or using my said machine is as follows: *viz.* I attach one end of the hide or leather by pins, or otherwise, to the roller G; and by turning said roller the hide or leather is wound thereon, and duly disposed so as to present the other end to the forcing cylinders A A. The knife H being so disposed and fixed as that the edge thereof shall be at the proper position for slitting; the upper cylinder is then to be pressed towards the lower by means of the screws B B, so as firmly to take hold of the hide or leather, the cylinders A A being made to revolve, will force the hide or leather against the edge of the knife, which will split or shave the same; and one part thereof will pass downwards at M, and the other upward at L. The roller G is resisted in its revolution

Pl. I. Vol. XVIII. Second Series.

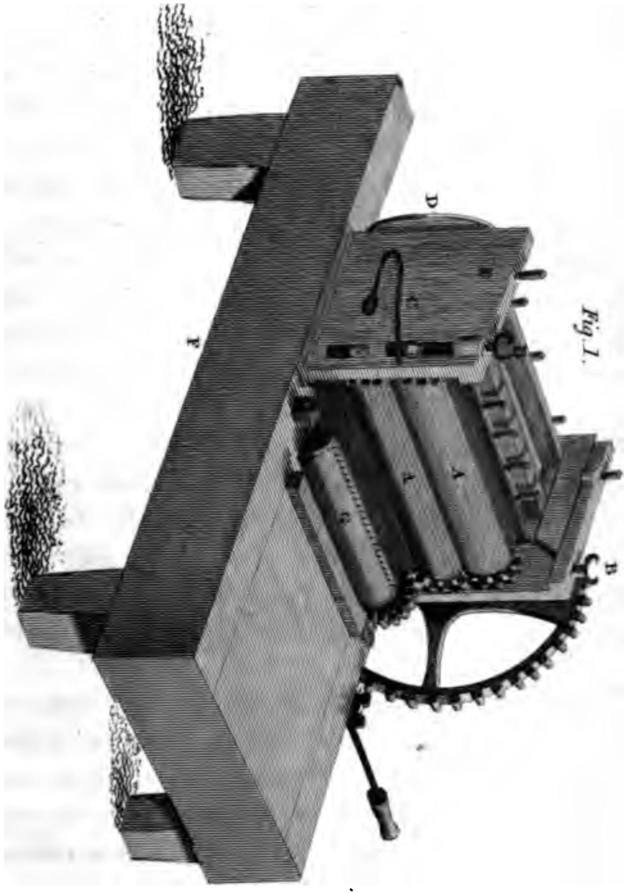


Fig. 1.

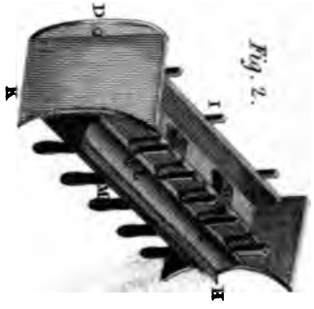


Fig. 2.

lution by a friction-lever, or otherwise, at pleasure, whereby any degree of tension may be given to the hide or leather as it is drawn off.

And farther I do declare, that the principal improvements in my said new method do consist in the use of a fixed or stationary knife, and in so placing and confining it as to meet the hide or leather before it escapes from the action of the forcing cylinders; and also in the construction of, and the manner in which a powerful action is obtained from, the forcing cylinders, whereby the hide or leather, as it passes through, has not room to deviate, but must necessarily be forced and proceed right onward to the knife, and undergo the splitting and shaving intended. By this machine the hides or leather are split or divided into any thickness required, and with great expedition; and when divided or split are left with smooth surfaces, and free from any marks of the knife.

And, lastly, I do declare, that the other particulars of the structure of my said machine, and of the forms and dimensions thereof, as well as of the fit and proper materials, are capable of being varied according to the size and nature of the work intended to be done; but that the same particulars are such as any competent workman in machinery of this nature will find no difficulty in providing for and constructing the same; and more especially that the sizes of the hides or skins intended to be split or shaved will determine the sizes of the cylinders as to the length thereof, and the other parts may be made to correspond, without reference to any scale in the drawings hereunto annexed.

In witness whereof, &c.

Specification of the Patent granted to FREDERICK ALBERT WINSOR, *of Pall Mall, in the County of Middlesex, Esquire; for certain Improvements upon his former Patent Oven-stove, or Apparatus for carbonising all Sorts of raw Fuel and Combustibles, and reducing them into superior Fuel of Coke and Charcoal, as well as for extracting and saving during the same Process the Oil, Tar, pyroligneous vegetable Acid, and ammoniacal Coal Liquors, and for extracting and refining all the inflammable Air or Gas so as to deprive it of all disagreeable Odour during Combustion, and rendering the Gas itself salutary for human Respiration when properly diluted with atmospheric Air, and various Methods of applying the above several Products to useful Purposes.* Dated February 7, 1809.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Frederick Albert Winsor do hereby declare that my said invention is described and ascertained in manner following; that is to say: The gas-light apparatus consists of two principal parts; the one serves to carbonise coals, &c. and extract the smoke by heat, and the other part to cool, decompose, and refine the smoke; both vessels must be made air-tight, to obtain a perfect analysis of coal, or other fuel, and combustibles. Philosophers have long since contrived to analyse fuel, &c. in very small quantities, by the well-known chemical apparatus of retorts and glass receivers; but the trouble, expense, and difficulty attending this operation, even on a small scale, has hitherto prevented any contrivance on a larger scale for the useful application

tion of the several component parts of coal and other fuel. Since my first patent, in 1804, and my publicly recommending the introduction of coke and gas lights by numerous advertisements, enlarged iron retorts and huge gasometers, have been, and are now made use of in some manufacturing towns, as appears by the Philosophical Transactions, those of the Society of Arts, &c. and also from the evidence in opposition to the Gas Light Bill in the last Session of Parliament. But such unwieldly, costly, and dangerous apparatus can never be used in private houses, nor for lighting streets, &c. Hence the following apparatus is entirely new in its construction and application, for it operates diametrically contrary to all the known chemical apparatus hitherto used, as well as to those enlarged charcoal ovens and gasometers employed by Messrs. Murdock, Boulton, Watt, and Company, of Soho, near Birmingham; those of Messrs. Phillips, Lee, and Company, of Manchester, as described in the Philosophical Transactions, and in their evidence before a Committee of the honourable the House of Commons, in opposition to the Gas Light Bill; those of Mr. Cooke of Birmingham, in Nicholson's Philosophical Journal; those of Mr. Clegg, of Manchester, as published by the Society for the Encouragement of Arts, &c.; those of Mr. J. W. Davis, of Tauley Moore, in Tilloch's Philosophical Magazine; and, lastly, those of Mr. Parkes's, in his celebrated Chemical Catechism. All these apparatus are on the principle of an enlarged charcoal furnace, (such as there are plenty about London,) connected with large gasometers. These ovens will contain iron retorts, full of wood or coal in the centre. A fire of raw coal is made to play around them; by which contrivance above half of the heat is necessarily lost in the brick-work, from the natural expansion and rarefaction of caloric always flying from the centre, whereas my fires and flues are always contrived in the midst of the raw fuel to be carbonised. The gasometers, or gas holders, contain large reservoirs where the gas is suffered to accumulate to one thousand cubic feet in bulk, which, besides the danger, prevents its being thoroughly decomposed and refined in such masses, whereas in my condensors, the gas is so infinitely subdivided into minute particles, that all its tar, oil, bitumen, and ammoniacal liquor, must needs be decomposed and precipitated before combustion.

First, house and chamber stoves may be constructed of iron or other metal, of earthen or stone ware, made fire-proof, of pipe-clay, or any other fire-proof composition. Their form in general is that of the German draft stoves, but they may be made round, square, angular, cylindrical, conical, oval, or any other fancy shape; and the cylinder which separates the fire from the coal inside may be made equally different in shape, provided that its bulk occupies from one-third to one-half of the area within the stove, so that the heat may more equally be distributed among the surrounding coal or fuel; for instead of surrounding any iron or other retorts filled with coal or other fuel to be analysed, by a large coal or charcoal fire, I place my fires into the midst or centre of the vessels charged with raw fuel; and I employ the refuse coke and coal only to burn in those cylinders or iron cones surrounded by said raw fuel; hence the fire and heat generated in the centre expand by the laws of nature in all directions, but chiefly sidewards and upwards, and a much greater quantity of caloric is thus generated by means of a good draft, and is more equally distributed among the coal so as to cause a speedier and more perfect carbonisation. By this mode the fires never come into contact with the fuel to be coked and decomposed, and no calcination whatever can take place; a very great saving is produced in the expenditure of raw fuel commonly burnt under and around these iron retorts, copper pots, and digesters employed in a like process, where above half the caloric generated expands from, but never towards a centre; hence it is sooner lost in the iron or brick-work inclosing it than it heats or carbonises the raw fuel placed in the centre of the fire or surrounded by its flames. These principles and effects have often been demonstrated, exemplified, and approved of in my numerous public lectures. By this method, one-third of a bushel of refuse coke may generate sufficient caloric to carbonise a whole bushel of coal, so as to produce one bushel and a half of good coke again, besides from five to six pounds of oil-tar, from seven to eight pounds of strong ammoniacal liquor, and from two hundred and twenty to two hundred and sixty cubic feet of pure gas, all which proportions will be obtained more or less, agreeably to the nature and qualities of the coal or other fuel; the said oil-tar may be converted again into several qualities and properties of essential oil, pitch and asphaltum, and the ammoniacal liquor may be beneficially applied by agriculturists, dyers, chemists, manufacturers of sal-ammoniac, carbonate of ammonia, and other more costly salts, by chemical combinations. The said coke may be beneficially applied to family, culinary, and chemical purposes, as well as for smelting iron, &c. on a large scale: all which facts have already been proved before a Committee of the honourable House of Commons, and which were ordered by the House to be printed. The cylinders or cones containing the fires may be so constructed as to give a horizontal, perpendicular, oblique, serpentine, or reverberating direction to the fire, heat, or flame, in its passage through the raw fuel or other combustibles to be analysed; the heat and flame may be led up and downwards, to the right and left, and in all possible directions through the carbonising fuel, for the longer the fire draft is detained in its passage, and the greater the circuit it makes through the fuel, the sooner and the better will be the process of carbonisation as well as the quality of products precipitated in the condensors.

Second, in my large succession stoves principally made of fire and other bricks, divided into several compartments and closed with iron covers, the fires run from one, two, three, four, or more grates, through a number of flues in the midst of coal, and meet in the centre at one chimney; these compartments are either larger or smaller, to hold from one peck to one sack and more of coal or other fuel, are charged and discharged in succession, without in the least interrupting the process of the other compartments, so that the operation of the furnace goes on day and night without any hindrance. From each compartment, a separate flue or conductor carries the raw smoke to the great main connected with the condensor, so that when one of them is discharging of coke, to be re-charged with coal, &c. the communicating flue or tube to the main is shut by a cock or valve, or otherwise, in order to prevent the access of air to the great main; but as soon as charged and covered in, the communication to the main is restored, that the raw smoke may freely pass to the condensor. In this manner furnaces of any dimensions or capacities may be constructed, and good coke may be made even of the refuse or siftings of coal, if forms of iron, clay, or wire like a frame-work, are filled with small coal, and placed within these compartments; this coal will make good coke cakes of any size or shape, by which means the breakage and its waste is avoided. The condensor, which is the next principal part of the machine, serves to cool and decompose the hot smoke and gas; for when suddenly and properly cooled, it will then precipitate its component oil, alkaline, and bituminous particles, much speedier and more perfect than in gasometers, where it is retained in large volumes; whereas, to perform a complete analysis, it should be as minutely subdivided as possible; for this purpose, my chamber stoves have metal, earthen, or stone vessels made in form of a pedestal, or any other convenient figure to support them: these vessels have several subdivisions or partitions filled with lime-water, or cream of lime, or lime diffused through them so far as to leave only from half an inch to two or three inches space (agreeably to the size and charge of the stoves) above the surface of the water. The lower chambers, where the tar and ammoniacal liquor collect, are without water, The hot smoke from the stove is led by a strong pipe either through or beside the fire-place and ash-hole into the lower chamber of the condensor, where it is minutely subdivided in winding round and passing through several side partitions perforated with small holes; from hence the smoke and gas strike upwards through a fixed tube on the first surface of water saturated with lime, which by its chemical affinity to sulphur, &c. attracts those offensive particles that otherwise accompany more or less the hydroc-arbonic gas from different sorts of coal and some other combustibles; from hence the smoke is made again to ascend by a tube, and to serpentine again as it were in minute subdivisions through several side partitions with perforated holes, over three, four, and more surfaces of lime-water, which all serve to cool, decompose, and refine it into pure gas; when it is examined by proper trying pipes, and when found quite transparent, it is then suffered to force its way through the main and side tubes towards the spots where the burners are fixed to give light. It is obvious that proper vent must be given in time for the smoke to displace the different columns of air contained in the condensors, main tube, and side branches; first by the trying pipes near the condensor, and secondly by those of the main, and lastly by the cocks or valves near the burners, otherwise the elastic pressure of the gas will force its way through some soft, thin, or porous spots in stoves, condensors, or pipes, where water and air cannot easily perforate. The gas may be used in ornamental, moveable, and flexible branches issuing from the condensing pedestals, such as has been shewn in a great variety at the Lyceum in one thousand eight hundred and four; in Green-street, one thousand eight hundred and five; and in Pall-mall since one thousand eight hundred and six to the present time; in Green-street, by means of two small stoves placed on each side of the kitchen fire made with coke and one separate condensor, the gas was conducted into the parlour and second floor above it; the tops of the stoves may be made in form of a kettle, pan, or other vessel, to make water boil by the hot smoke before it passes into the condensor, or be made serviceable for other culinary and chemical purposes. Large iron stoves and succession furnaces have separate condensors placed at a few feet distance from them, so that they are not in the way of charging and discharging the stoves, nor of being injured by the heat. The tops of these stoves have upright ledges or shoulders with alembic covers to serve for evaporating or distilling tar, &c. &c. by the same heat, and also to form a sand bath for the purpose of any other evaporation, distillation, &c. These condensors may be made of brick or stone-work lined with lead, &c. or wholly of iron, tin-plate, or other metal, and even stone or earthen wares; but the cheapest and simplest are made with large wine or other casks cut in halves, with several bottoms made of wood or metal in the manner above described, to hold several surfaces of lime-water. Should the coal be of a strong quality, it will be proper to throw a small quantity of slaked lime at the bottom of the stove sprinkled over with a little water; the steam of which will rise through the coal, and impregnate itself with the smoke, to purify it the better from the disagreeable odour. Formerly I used to mix a small quantity of lime with the coal, but this affects the coke more or less; and I find that throwing lime into the bottom of the stove answers still better, and the lime is not intermixed with the coke. Persons using reservoirs, gasometers, or gas-holders, are ignorant of the effect the pressure of air has on the main tubes and side branches, when left open in the beginning and towards the close of the process. It is well known that the atmosphere presses with a force of fourteen pounds on every square inch surface: hence if an aperture of only the fourteenth part, the pressure is one pound. Now at the beginning of the process, when the gas has not yet obtained sufficient elastic force to displace the air within the tubes, although the reservoir or gas-holders may be quite filled, if you attempt lighting too soon, the blue flame will frequently be forced inwards by the superior weight of the atmosphere, when it rushes with the rapidity of lightning through any length of tube into the reservoir, and explodes it with a force equal to gunpowder; hence the larger the reservoir or gas-holder the greater the danger. The same effect must take place towards the close, when the elastic pressure of the gas must become inferior to that of the atmosphere; and wheresoever there is a flame left burning, accidents are likely to happen, as the cause of danger still exists the same as in gunpowder mills which may stand safe for years and be blown up at last. No human ingenuity can prevent the explosion of gas where it is suffered to accumulate in any quantity, for it is impossible to guard against it with any safety valves or other contrivances, as is done with steam-engines, the bursting of which, however, rests on different principles. The principle of placing a fire in the centre may be applied to heat or boil, distil or evaporate water or other liquids in wooden casks or other vessels, much sooner than can be done in the common mode of applying the heat under and around kettles, coppers, pots, pans, &c. It may also be applied for airing, drying, baking, stewing, &c. In any of the fire places in my stoves and furnaces, a strong metal or fire-proof composition tube may be led through the middle, supplied with fresh air by a tube connected from the outside through a wall or otherwise. By this means a great quantity of fresh air may be speedily rarified, heated, and be conducted by other tubes fixed and flexible to warm rooms, and even whole houses, in a far superior and safer manner than can be done by steam or fire flues now in use.

In witness whereof, &c.

Specification

Specification of the Patent granted to Mr. WILLIAM WATTS, *of the City of Bath, Gentleman; for Methods of combining and disposing Machinery, and applying the different Powers of Wind, Water, and Cattle thereto, so as to effect Improvements on Mills.*

Dated September 26, 1809.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Watts do hereby declare, that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say:

In the drawings hereunto annexed, Fig. 1 (Plate II.) represents the machinery for forming a wind-mill of great power, shewn through the head of the mill A A. B B are two drum-wheels, having at each end iron plates C C, in which are cavities D D, at regulated distances, to receive the axles E of the sails. Over the drum-wheels B B, work two chains F F, connecting at regular distances the axle of each sail E; these axles in going round the drums B B fall into the cavities or catches in the plates of the drum D D. On each end of every axle is a small wheel running in a channel formed in the framing of the mill, and shewn by the lines H H top and bottom, and serve to steady the sails. Upon each axle is a frame I I, which frame has fitted within it, and playing on a joint or pivot at bottom, another frame; to this inner frame is fastened the sail J J, which may be of canvas or other materials;

on each side of the outer frame I I, is a support of wood or iron K K, and runs from the axle of the preceding sail (on which it turns) to the upper part of the succeeding frame I I, playing on a pin. These are supports to the frames against the power of the wind, and which, by playing top and bottom, allow the sails to turn round the drums at each end; at the upper ends of each outer frame is fixed a sheave or pulley M M, over which passes a rope, this rope is fastened to each upper corner of the inner frame or sail at one end, and at the other end it has a spring N N, which spring has two small grooved wheels running in a channel: this channel is contracted more at the upper than lower end, so as to produce whatever resistance you wish the sails to make against the wind. These springs N N regulate the sails, so that wheir they receive too great an impulse, they pull the springs on each side and the sails recline, letting the extra power fly off, as shewn in Fig. 2.

The body of the mill may be of various shapes and dimensions, as described by the dotted lines O and P. Where much room is wanted for a manufactory, it may form a circle as P; and also as represented in Fig. 3, where it is shewn placed over a fixed storehouse Q, on which the head turns at S S; but where little machinery is wanted or no manufactory, as in mills for drainage, &c. it must have its length, but there is no necessity for its being near so wide, as shewn by the dotted line O, though the base must be sufficiently extended to make it safe against the wind.

The head A A may travel round on wheels and in a channel, and being placed to such an angle of the wind as where the sails act to the greatest advantage, (the under sails being sheltered from the wind and the upper ones

Pl. II. Vol. XVIII. Second Series.

Fig. 1.

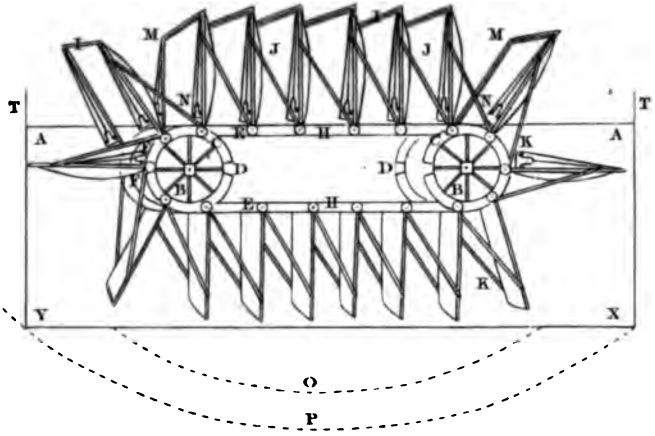


Fig. 2.

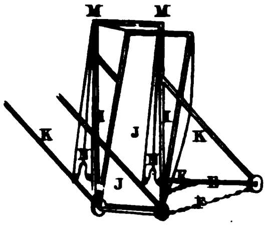


Fig. 4.

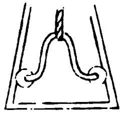


Fig. 3.

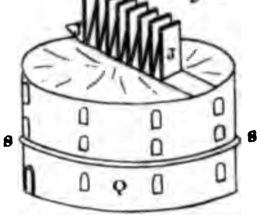


Fig. 8.

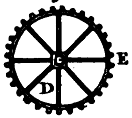


Fig. 7.

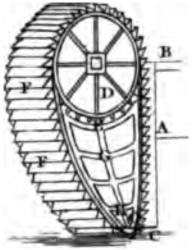


Fig. 6.

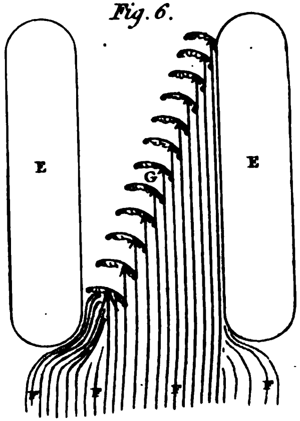


Fig. 10.

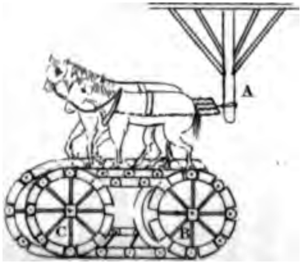


Fig. 9.

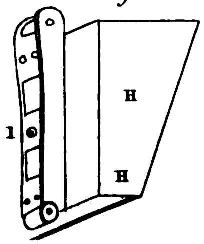
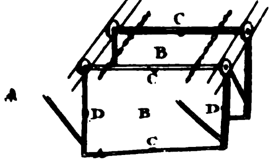


Fig. 5.



ones receiving it in an angle between each other) they pull round the drum-wheels B B by their extremities, to the shaft of which is fixed or coupled the manufacturing machinery, &c.

The width of the sails, and the distances from each other, must be so regulated as that the wind may strike the sails sufficiently at the same time, not to make the angle of the line of sails with the wind too great.

Only eight sails are here represented in action, but the number is not limited; the power may be carried much farther by increasing the distance from drum to drum and adding sails in proportion; and adding length to the sails increases the power in proportion to the increase of sail, without losing time, which is not the case in the present vertical mills. The sails must be made full to form a concave surface to the wind.

Fig. 2 shews a sail borne down in part by the extra force of the wind. E E the axle and wheels. I I the outer frame. J J the inner frame and sail. N N the spring, rope, and guide. K K the supports to the frame I I. F the chains.

Fig. 3 represents a mill formed circular and placed over a fixed storehouse. Q the store. A A the head. S S where it turns. J J the sails.

Fig. 4 shews the spring and guide in large.

The machinery for a floating tide or current mill of great power, I form similar to the preceding one for wind: therefore the same drawing will serve to refer to, only allowing the lower sails in Fig. 1 to represent the floats of this, and the water to flow from X to Y, towards which they act. These floats may be of wrought-iron or other materials, and will in general be broader than deep, though, as in the wind-mill, must form a concave surface to the current, which if running only one way, the concave side of the float may be so fixed; but as by tides, where it operates both ways, it is made to turn on a pivot in the centre, above and below, of the frame, as shewn in Fig 5. A is the frame. B B the floats. C C the pivots on which it turns, and when its concave side is placed to the current, it is fastened on each side at D D; but to shew the disposition of the floats and works in action, see Fig. 6, which represents two boats E E, that must be connected together by proper framing, &c. which framing may pass between the upper and lower line of floats.

The boats are placed parallel with the current F F F F, and between them is fixed on a proper angle with the current the floats and machinery G. Here 121 floats are constantly acted upon by the current: though in this as in the wind-mill the number is not limited; the longer are the boats the longer will be the line of floats, and the power is increased in proportion. It is to be observed that the floats should always be made as deep as the current will admit of, for in this as in the wind-mill you gain power without losing time.

The drum-wheels, chains, and axles and wheels, are the same as for the wind-mill; but as water is a steadier power than wind, the springs are not required to this, and are omitted in the drawing for the lower sails.

Fig. 7 represents the improved machinery for a water-mill, or a mill so called, as receiving its power from a fall of water.

A the upper water, and flowing out at B. C the lower or back water. D are two or more metal wheels through which passes a shaft. These wheels have on them cogs or stumps E, shewn also in Fig. 8, at regulated distances, that is about the depth of the buckets; over these wheels work a connexion of buckets F F: these buckets are united by metal joints and pins, as shewn in Fig. 9. I the metal joint. H H the end of a bucket in large. Two or more of these joints (according to the length of the buckets or strength required) are screwed to the back at proper distances. These joints have each of them two mortises, though only one is in use at a time; the other is made to lighten the metal and to form a change, should they wear; and the joints admit also of a further change, for the mortices being at true distances they may be turned contrary ends. These mortises are at distances when united corresponding with the cogs or stumps on the wheels D D with which they act, so that one cog may have hold of each bucket to prevent the weight of water in the descending buckets slipping the empty ones over the wheels D, without effecting their purpose. G is a framing of wood fixed in the side-walls of the conduit, having on the front of it one or two small rollers at the point H, where the buckets incline to turn, but the frame itself is not allowed to touch the buckets unless from accidental cause, when it serves to steady them.

The buckets may be of the usual shape as for the present overshot wheels, and may be formed of wood, iron, or other materials; the sides and ends are secured together, but the bottom board or plate I make to open inwards by joints or pivots fixed to the back, and this board or plate acts as a valve, and rests when down on a narrow ledge on the inside of the sides and ends of the bucket, to which it is made to fit close. Or it may be made with the bottom board or plate fixed, and in that may be formed a valve to open; either one or the other method I always use, or every bucket has in rising out of the lower water to raise the whole water it contains the depth of each bucket.

The water being let on at B, and the buckets being filled from thence to the lower water C, which is the extent of the fall, they overpower the resistance; and when immersed and inclined to turn round at bottom, the bottom board or valve opens, permitting them to pass freely through the lower water, ascending up to the wheel on the opposite side bottom upwards; but before they arrive at the point B to receive another supply of water, the bucket is in its right position for it, and the valve closes for another operation.

This action of the connection of buckets pulls round the wheels D by their circumference which is the extremity of the lever, to the shaft of which is fixed or coupled the manufacturing machinery, so that every 100 pounds of water employed in the fall acts with its full gravity on the lever; that is, producing 100lbs. of power (setting aside friction), whereas, by the plan of employing the water on the semi-circumference of a wheel, as the present overshot and breast, every 100lbs. of water so employed produces only 50lbs. of power (setting aside friction). The still greater loss of employing undershots which act by impetus or force of water is so well known as to be almost unnecessary for me to mention, being allowed to be double that of the overshot and breast, or that 100lbs. produces only 25lbs. of power (setting aside friction).

So that overshot and breast-wheels lose the effect of full one-half, and undershots three-fourths of the water employed, independent of minor defects, as those of the buckets losing part of their water before they arrive at the extent of the fall, and that the width of one bucket in an overshot, and half a one in the breast-wheels, is constantly lost in the fall.

The machinery for cattle-mills is upon the same principle as for the wind and floating-mill, being a connection of planks united by joints, and having at their ends, wheels travelling in a channel of the framing round two drum-wheels B and C Fig. 10, to the axle of which is fixed the manufacturing machinery, &c.

The drum at B, if preferred, may be placed lower than that at the head of the horses C, so as to cause the cattle to act in part by their gravity, as upon an inclined plane.

The cattle drawing from a fixed point A, and pulling round the drum-wheels B and C, with the machinery, &c. by the power of their feet, enables them to work constantly in a straight line, by which means they travel much faster with much greater ease, and performing much more work, than by being constrained to travel round a circle.

Note.—It may be necessary for me to observe there is a similarity in appearance between my plan of working mills by a fall of water, and a method published several years ago by Dr. Desaguliers. Had the Doctor's method proved useful for moderate or small falls, or perfect for great falls of water, any other plan might have been unnecessary; but the machinery is defective. The friction and obstructions operate too much against the power gained, and though in very extensive falls the disadvantages are less in proportion, they are too great to be of general utility.

In witness whereof, &c.

New Mode of improving Grass Lands.

By Mr. SALTER, *of Norfolk.*

From the COMMUNICATIONS to the BOARD of AGRICLUTURE.

As Mr. Coke, President to the Norfolk Agricultural Society, has expressed himself in terms of approbation so highly gratifying to me upon my method of improving poor pastures and boggy meadows, and particularly when he honoured me with a visit this summer for the purpose of examining a meadow, which was then in its highest state of improvement with a crop growing upon it; I readily comply with your request, and have sent you the best information I can of the method, which I have pursued now ten years in that line of farming; a method, which originated in accident, but which has been ever since carried on systematically.

At Michaelmas 1795, I entered upon this farm, consisting of upwards of six hundred acres, of which the greatest part is wet, springy, cold land. There were at that time, about one hundred acres of bad meadow, so over-run with rushes, sedges, and all sorts of aquatic plants, that no sheep had ever been known to be pastured upon them; whereas, for the last eight years, I have not had a single instance of a rotten sheep. I first cut the rivulet, which runs through the meadows, three hundred and fifty-two rods in length, (reckoning seven yards to a rod,) and eight feet wide. I also cut one thousand one hundred and sixteen rods of open drains; and the turf or sods, which came out of them, I laid to dry in the months of February and March; and as soon as dried I gathered them on large heaps of sixty and a hundred loads, and burnt them to ashes. On the second of April, 1796, I dibbled about two acres of that part of the meadow, which was most dry, and immediately I carried on, in half-load tumbrils with broad wheels, about fifteen loads *per* acre of the turf ashes: then I sowed sixteen or eighteen pounds of Dutch clover, and four bushels of ray grass; *i. e.* eight or nine pounds of Dutch clover, and two bushels of ray grass *per* acre. These I brushed with a pair of harrows bushed, and rolled three or four times with a very heavy roll, in order to make them as firm as possible. Upon that part of the meadow, which was boggy and rushy, I laid from eighty to an hundred tumbril loads *per* acre of sand, fine gravel, and mould, as I could most conveniently come at them, cutting and carrying away every hillock or waste earth, which I could find. Having harrowed and rolled this, I dibbled upon every acre two bushels of summer vetches, one bushel of early grey peas, and two bushels of Poland oats, all mixed together; and then sowed Dutch clover and ray grass as I did upon the dry part of the meadow, in which I omitted the oats, knowing they would not have succeeded.

In dibbling thus, the holes ought to be four inches square from each other, and from two to four seeds should be put into a hole. Peas and vetches thus growing upon grass land, whether on low meadows or dry uplands, have never failed with me of having excellent effect. They entirely destroy moss, and ameliorate the soil. It is to be observed, that upon dry uplands I omit the ray grass. When the crop is forward in the pod, I mow it for hay; and as soon as it is dry, I put it upon small cocks, and then on to large ones, so as to prevent the leaves from falling off. If I do not want this hay for my sheep, I cut it for my horses; and it is so nutritious, that it serves both as hay and corn.

In the year 1803 I grew thirty acres of vetches, peas, and oats, managed as above: the crop was not less than from two and a half to three loads *per* acre: by a load, you know, I mean as much as a waggon drawn by four horses can carry. In the same year I sowed one hundred acres of turnips three times over, and at last lost my whole crop, except a single turnip. I had 532 breeding ewes to maintain in the following winter. Having provided thirty troughs twelve feet long, and a straw-cutting machine, (which with a horse will cut ten coombs an hour,) I cut the hay made of the vetches, peas, and oats, and thus fed my sheep, which produced me a greater number of lambs, and a greater quantity of milk for the lambs, than I ever had from turnips. They were kept in the straw-yard from the 10th of October to the middle of April; and thus I kept them last year, and shall always keep them whilst I remain upon a heavy-land farm. They eat the straw well, and make a far better yard of muck, than that from bullocks. It was by much the best muck I ever had, except a yard of muck, where I fatted 220 pigs, by scattering peas about the yard.—As a proof of my success in lambs in the year 1804, my shepherd Thomas Nunn, gained one of the premiums (five guineas) from the Society.

In February, 1805, a seventeen-acre meadow was become solid: I filled up the open drains, and cut nine hundred and ninety-five rods of under-drains, which I filled up part with bushes and part with stones. Upon April 4th, I began to dibble vetches and peas; then carried on about 15 loads *per* acre of out-hollowing, muck, and mould together; sowed Dutch clover and ray grass, and brushed them as usual: the crop was abundant—I got 63 loads of hay from the 17 acres. This was the meadow which Mr. Coke, Mr. Gurdon, you, and other gentlemen admired so much, and deemed an improvement in the management of grass land deserving of high commendation.

I will not omit to tell you from what accident this method of managing grass lands originated:—In the year 1784 I had a piece of grass land eaten up by grubs: I sowed vetches upon it, and harrowed them. They produced so good a crop, that I have continued the practice to the present time. Indeed I carry it on in every instance where I can; for whenever my lays of clover fail, instead of breaking them up, I dibble or drill vetches early in the spring. It is worthy of remark, that the ray grass and Dutch clover upon my meadows come much earlier, and grow faster, than the lays upon my arable land.—Be assured, that I shall have pleasure in attending you to Reepham to examine your pasture there, in order to *salter* them, as you are pleased to call my method of improving grass land,

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P. S. I as often use the drill roll for the vetches and peas, as I do the dibbles; please to observe also that I never plough, pare, or scarify my grass lands.

[illegible]

[illegible]

From the Communications to the Board of Agriculture.

[illegible]

[illegible]

ner as horses. Not more than two were used at any time in a common single plough, which was held by the man who drove them, without an assistant. In the waggons and carts the oxen went single, or one before the others, as the load required; and very readily understood the call of the driver, to turn to either side, stop, or go forward. In 1784 I took a farm of 500 acres into hand, chiefly arable, and the lands much disunited; I therefore bought some horses and worked them at the same time with the oxen, but generally apart, as I think it is best to do so. I sometimes sent out two waggons; one drawn by six horses and the other by six oxen, the distance 23 miles; the load to each, twenty quarters of barley to carry out, and two chaldrons of coals to bring home. The two teams set off about one o'clock in the morning of one day, and performing the journey with equal ease, regularly returned about two o'clock in the afternoon of the next. As a further proof that oxen are not so slow in work as is generally supposed, it may be worth while to mention one instance of their ploughing. A field of 19 acres had been laid to grass four years; and as it was not a good layer, I determined to break it up. It had been laid down as level as possible: the ploughman therefore took a pair of oxen in a single plough to draw out the field into regular lands; and afterwards a double-breasted plough with three oxen, and ploughed all the land with that, except the head lands and short land at the corners, for which he used the single plough; and, without any fatigue to himself or cattle, he finished the 19 acres in eight days, the whole being executed in the best manner. Indeed I frequently observed that when any fields contained more in measure than the workman estimated, the oxen in the single plough ploughed more than one acre in the day, and in the double plough more than two. I had usually fed my bullocks in the winter with a limited quantity of turnips whilst at straw; but finding in my enlarged occupation that my flock of sheep wanted all the turnips I could raise, and that I must diminish the number of my sheep or part with my oxen, I resolved, most unwillingly, upon the latter, and for some time had horses only. But at Michaelmas, 1801, I reduced my farm to about 90 acres of arable, 70 acres of pasture, and 27 acres of wood and plantations; and I reserved four horses, intending to substitute oxen in their place. There are but few reared in this county, and those chiefly by farmers for their own grazing: and oxen in general being then excessively dear, I purchased two bulls, nearly three years of age, from the dairies in the neighbourhood; neither of them had been worked. As it may be of some use, I will here detail my method of breaking them. They are first made to walk, till they appear somewhat tired, and then by the gentlest means they are harnessed and bridled with bits in their mouths. A piece of timber ten or twelve feet long with a strong staple at one end, is placed in an open field, and the bull is fastened to it by very long traces, to prevent the log from hurting him. He generally makes several strong efforts to disengage himself by running forward, which he is permitted to do for a short distance; but two men on each side keep fast hold of a strong plough-line (which is fastened to each side of the bit before he is let out) and the log restraining him behind, he soon finds himself overpowered and goes more quietly. An old horse, or ox, is then put on before him, and they draw the load jointly some time, but not to fatigue him too much. He is thus exercised twice a day, and when he is more manageable, generally on the second or third day, is put into a plough with his partner, and a man walks by his side a few days to teach him to keep in his work, turn, and obey the voice and reins of the ploughman. During the whole process it should be remembered, that by patience and good usage only the ox is a most docile animal; but if ill treated, either his spirit fails, and he will make no exertion, or he may be irritated to madness. The want of exercise, as well as his not having arrived at maturity, make it necessary to bring him gradually into full work. My bulls as well as oxen, in two or three weeks, become very gentle, are put into carts or waggons as wanted, and upon the whole brought to hand more easily than colts. The most active are selected as leaders; and an extraordinary share of work is allotted to those that are least manageable. After one of my bulls had been broken some time, I found he had really been vicious before I bought him; and that if turned into the pasture, or rested for some time, he resumed his old habits; my orders then were, that, on all occasions, he should be the first taken to be worked: that has rendered him perfectly quiet, and he is a remarkably good beast. Bulls are cheaper than oxen, and I believe, will do full as much work: but, I am now rearing an ox to be worked with the bulls, to ascertain that point. The only inconvenience in keeping them is, they cannot be turned out to graze; but most agriculturists will scarcely think that a disadvantage, as it is generally better to soil working beasts in the stable. But to resume the account of my farm: as soon as one pair of bulls were brought to work I parted with two horses; and for three years two horses and two bulls did all the work, with the occasional assistance of a horse. They constantly worked together, and both in ploughing and carting the bulls kept pace with the horses. In 1804 I broke in another bull, and in 1805 a fourth, putting away a horse as each bull was taken to supply his place; and from that time to the present the four bulls have done all the work, assisted for a few weeks by an old horse in seed time and harvest, which was the more necessary, because one of the bulls was only eighteen months old when I first broke him. Since I finished sowing wheat I have had the four bulls only; and besides tilling the fallows and the spring sowing, they have done a great deal of work in carting timber, wood, and manure, and carrying corn to the market town, ten miles, &c. They have, when the roads were particularly good, carried fifteen quarters of barley, and brought back two chaldrons of coals. The four certainly could do all my business, but I wish for a fifth, to prevent stopping a pair, when one only is wanted, and to guard against accidents. The average price of my bulls is 12*l.*; their average height 13½ hands, and weight 12½ cwt. when alive. Upon 30 acres of my stronger land a pair are used in a common plough, and plough one acre per day. Upon the light land three are put into a double plough, and regularly plough two acres a day with one man only. After the land is made fine, in the spring and turnip sowing, the bulls are put single into a light plough, and three of them plough three acres, whilst the fourth does the harrowing. My turnips are generally sown with Cook's drill, and much of my wheat;

all with the bulls. They are shoed * in a pound, of which a plate and description is given in page 499, vol. ii. of the Annals: and in that respect are always more troublesome than horses. But my general mode with horses and oxen is for them to make two short journies, rather than one long one, in a day; being persuaded it is much better for the cattle. They go to work at six in the morning, return at eleven; set off again at two in the afternoon and return home at six. The pound is near the stable, and the bulls are shoed between the two journies without loss of time. I will now request permission to state my reasons for preferring oxen or bulls to horses:

1st. The prime cost and hazard by loss of course is much less — frequently not one half.

2nd. There is a great saving in the comparative expense of keeping them and horses, as they require no oats. The regular allowance to mine is two bushels of bran in a week to each, mixed with the corn chaff: this is given them with straw in the winter, and with hay, for six weeks, in the time of spring and wheat sowing, and with clover, tares or grass mown for them in the summer, and they are almost constanly at work. At a very moderate estimate I think there is a saving of near 10*l. per annum* in the difference of keep of each beast and a horse, with tax and decline in value included.

3d. The decline in value, so considerable in horses, amounts to nothing in oxen. One that has been worked will fatten in much less time than a younger one which has not; as I have been informed by those who bought oxen of me to fatten, which had been in work ten years.

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* N. B. I have no doubt that oxen are shoed with more ease by slinging them up by a long lever frame, of which there is a description and plate in the 6th quarterly number of the Annals, page 75. And I intend soon to erect a frame of that sort, but shall first look at that abovementioned.

4th. They are much less liable to illness than horses; and in case of blindness, or incurable lameness, can be disposed of without loss.

5th. If the use of oxen became general, a considerable addition would be made, both to the quantity of animal food, when they are slaughtered, and also of vegetable food, by diminishing the quantity of land applied to the growth of oats.

6th. It frequently happens, that horses (especially those belonging to gentlemen) are much injured by riding them without the master's knowledge, which cannot happen to oxen; nor are they so liable to be driven too hard on the road to recover time lost at alehouses.

Perhaps it does not often happen that a farm is cultivated with so few working beasts in proportion to its extent as mine is. That, and the whole of my success in working oxen as well as bulls, I attribute chiefly to this circumstance; that instead of turning them off at four or five years of age, as is usual, I consider them then not only most handy, but much more able to work; and my constant practice is to keep them, till they begin to lose strength or activity, which I have not observed before they are fourteen or fifteen years old. But although, from experience, I most decidedly prefer oxen to horses, I cannot recommend any one to adopt the use of them in a district where they are not common, unless he has opportunity for a considerable time to inspect the treatment of them on their first introduction. I presume there are few members of the Board of Agriculture who have not found difficulty in bringing any novel practice amongst their workmen, and how much it is in their power to prevent success. But in an attempt to substitute oxen for horses, every one employed, from the steward to the stable boy, though he may not have honesty or courage to declare his sentiments, is certain to be adverse to the plan. The first very ill consequence is, that the instant the master is out of sight, the poor beasts are cruelly treated; and the next, that by driving them too hard, before they are brought gradually to exercise, they tire them so much as to render them unable to make any further exertion; or, without reason, they take so many more oxen than horses for different purposes, that the owner finds both his expense and trouble increased, and is generally induced to give them up. There is no question but oxen are best adapted to strong and heavy soils; but by the use of a light plough, drawn by a single ox, and the double plough drawn by three, as above described, the tillage of a light-land farm is performed with nearly equal advantage. I have for these ten years used one-horse carts, and find that bulls or oxen are perfectly handy in them; and in general able to carry a heavier load than horses: and I shall conclude by observing, that I would not exchange my four bulls, originally under 50*l.* in value, for the best four cart horses in the kingdom.

April 16*th*, 1807. X X X.

P. S. There have been several instances of oxen and bulls put to work in this neighbourhood since mine have been introduced; and I am confident the sole reason they are not become general is, that farmers have not sufficient resolution to overcome the prejudices of their servants and labourers.

Rougham Hall, near Bury St. Edmunds.

X X X. is the signature affixed to a memorial addressed to the President of the Board of Agriculture by me, R. KEDINGTON.

N. B. The Board may be assured the subscribing witnesses are principal occupiers in the parish; and more signatures would have been affixed, but I wished to select those who had lived *the whole thirty years in the parish,* which the first five had, and the sixth has been resident more than twenty years.

WE the undersigned inhabitants and occupiers of land in the parish of Rougham, in the county of Suffolk, do hereby certify, that the Rev. R. Kedington has employed horses, oxen, and bulls, upon his farms in this parish nearly for the space of thirty years, as stated in his memorial. And we do also declare that it is a true and just account to the best of our knowledge and belief.

Witness our hands, this 17th of April 1807.

ROB. ALDERTON.	SAM. CRASESE.
DANIEL ALDERTON.	WILL. HAYWARD.
JOHN HAYWARD.	JOHN DENTON.

Account of an Apparatus for cleaning Chimneys. By Mr. SAMUEL ROBERTS, *Chairman of a Committee appointed at Sheffield for encouraging the Sweeping of Chimneys without the Use of Climbing Boys.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Society, anxious to relieve the sufferings of humanity, have attended with much pleasure to the Endeavours of the Inhabitants of Sheffield, and co-operate with them in their attempts to supersede the Necessity of employing Climbing-boys; they have, therefore, immediately on receiving the following Communication, ordered it to be inserted in their Volume, and an explanatory Engraving of the Machinery employed to be annexed.

The original Drawings are preserved in the Society's Repository.

I HAVE taken the liberty of sending herewith some papers, and a request from the Committee formed here for encouraging the use of machines in sweeping chimneys, that you will have the goodness to lay them before the Society instituted for the Encouragement of Arts, &c. It is the wish of the Committee here, that they should be published in that Society's Transactions, as appearing the most likely method of drawing the attention of the public to the subject. We think there will be a necessity of an Act of Parliament; and, without that, no great good will be done in the business.

In making this statement to the Society instituted for the Encouragement of Arts, &c. respecting an object which has frequently engaged their attention, the Committee who make it are actuated by a desire of putting the Society and the public in possession of all that information which they have obtained from extensive experience, thereby enabling the Society to form a more accurate and just estimate of the degree of probability that there is of final success, than they otherwise might be able to do. As the Committee mean not to found any claim to reward, they have only been anxious to convey the information in the most convenient and ready way, without perhaps exactly observing the forms prescribed by the Society. The same considerations which have so frequently pressed themselves upon the notice of the Society, respecting boys employed by chimney-sweepers as climbers, operated on the minds of many individuals in this town, and upwards of two years ago gave rise to a general meeting, which appointed a Committee for the purpose of endeavouring to improve their situation, and of superseding the necessity of employing them at all, by substituting machines for that purpose. This Committee procured by subscription a sum, which, though not large, has hitherto served to defray those expenses necessarily incurred in the prosecution of the object for the attainment of which they were appointed. The Committee then procured one of the machines from Mr. Smart, and engaged a clever, active man to undertake the working of it (having first offered it to all the regular sweepers, who refused it). The Committee then endeavoured, by public and private application, to induce as many of the inhabitants as they could to encourage the use of the machine; in which endeavour they were as successful as could have been reasonably expected. As all the regular chimney-sweepers have endeavoured by every means in their power to impede the use of the machine, the Committee found it necessary to procure a boy to assist the man with the machine, and in cases where necessity required it to go up the chimney, because the regular chimney-sweepers refused to suffer their boys to complete the sweeping of those chimneys where the machine had failed. The brush procured from Mr. Smart being found rather difficult to work, and liable to be out of order, the Committee made, and caused to be made, many experiments for the purpose of improving it. Those of which they have sent drawings, (Plate III.) Figs. 1 and 2, seem to them the most simple, the most easy to work, the most durable, and the most efficacious of any which they have tried or seen. The result of all the experience which the Committee have now had is, that though probably nine-tenths of the chimneys in this town, as they now are, might be swept with the machines, yet that not one in ten of those will voluntarily be permitted to be swept by them, however much the Committee may exert themselves, because it probably will always take up some more time in the operation, and there is some risk in the first instance that the chimney may not admit of being swept by the machine, and because the ordering of it is generally left to servants, indifferent to the object, and inimical to new experiments, which might cause them more trouble. It is very possible, by stating striking and recent cases of oppression and suffering, to arouse humanity to expressions of sorrow and commiseration, but not often to great and continued efforts to assist, especially if it require any sacrifices, however trivial. It therefore follows, that, unless the method of sweeping chimneys with machines can be rendered less expensive and less inconvenient than by boys, (a thing not to be expected,) the practice will never voluntarily become so extensively adopted as to diminish in any considerable degree the number of climbing boys. The Committee are therefore decidedly of opinion, that the object which they are endeavouring to reach, can be in no other way effectually obtained than by an Act of Parliament prohibiting chimney-sweepers from taking any more climbing-apprentices, and from employing any others than apprentices as climbing-boys. The Committee are of opinion that such an Act would effectually produce the desired end, without subjecting either the public or chimney-sweepers to any very serious loss or inconvenience, because the chimney-sweepers would have an opportunity to get into the practice of using the machines, before the present apprentices were out of their servitude, and the generality of those chimneys, which now cannot be swept with the machines, would be easily so altered as to render them capable of being swept with them, and all new chimneys would of course be so constructed. The Committee further feel confident, that the attention and ingenuity of able mechanics and others interested, would be so much turned to the completion of the object, that very considerable improvements in the machines, and in the manner of working them, would be very soon made. As one of the most likely methods of producing the effect, the Committee have thought it right thus candidly to state their sentiments and opinions to the Society, to whom they will be happy to give any further information in their power, which may be thought likely to conduce towards obtaining the object of which they are in pursuit. The Committee need not attempt to describe the degree of suffering, consequent deformity, great depravity, painful diseases, and frequent loss of life, which attend the present practice to so many thousands of helpless and unoffending children, who might otherwise become happy, useful, and worthy members of the community, because the Society were fully satisfied on these points long before the Committee who now address them were called upon to assist in the endeavour to remedy them. That the Committee have not been exaggerating the capability of the machines, (imperfect as they must be admitted at present to be,) is evident from the list sent herewith of such chimneys as have been swept with them here during the first twelve months, being upwards of twelve hundred, in spite of all the prejudice, opposition, and difficulties against which they had to labour, also from the number of respectable signatures approving of and recommending, after trial, the use of the machine. For it must be recollected, that it is only amongst the more opulent inhabitants, and, consequently, in the highest and most difficult chimneys, that it has hitherto been principally used, because, amongst the lower class, the regular chimney-sweepers have been accustomed here to sweep for the soot only, a practice not yet adopted with the machine. The man employed here with the machine states, that if he had tolerable regular employment, at six pence each chimney, it would pay him very well. The Committee were very fortunate in engaging a person well qualified and active in the use of the machine, who has, under their inspection and directions, used his utmost endeavours to promote the success of the machine, both by improving and facilitating the use of it.

As it did not appear probable to the Committee that there would very soon be any great diminution made in the number of climbing-boys, they have not been inattentive to their welfare and comfort, but have endeavoured as much as was in their power to soften the rigour of their treatment, and to improve their situation. As the act for the regulation of chimney-sweepers and their apprentices was found to be so negligently drawn up, and so loosely worded, as to be utterly inadequate to enforcing proper treatment, the Committee, with the advice and co-operation of the magistrates, induced the master chimney-sweepers voluntarily to agree to certain regulations respecting the treatment and employment of their boys, which the Committee trust will be attended with considerable benefit to the poor children. The plan of having them to dine on Easter Monday, will give the Committee an opportunity of inquiry respecting the treatment which they receive, of giving them good advice, and of rewarding those who have behaved well.

We, the master chimney-sweepers, resident in Sheffield, whose names are underwritten, do agree to the following resolutions:

1. That we will not take any boy as an apprentice, under the age of eight years, nor will we bind any one to continue longer in servitude than he is sixteen years of age.

2. That we will not send out any boy to work before four o'clock in the morning in summer, nor before five in the winter, in the town.

3. That we will not permit any boy to go out to climb a chimney after twelve o'clock at noon, nor will we suffer

Pl. III. Vol. XVIII. Second Ser

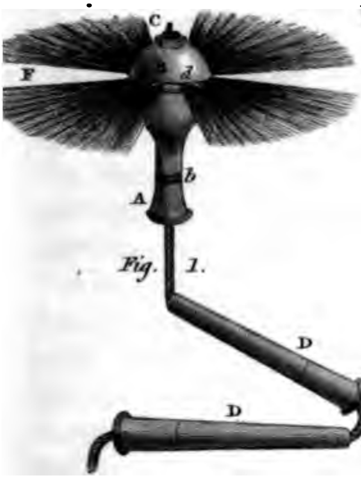

Fig. 1.

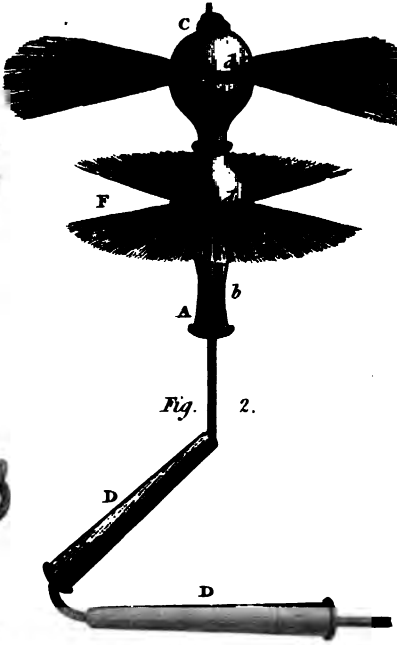

Fig. 2.

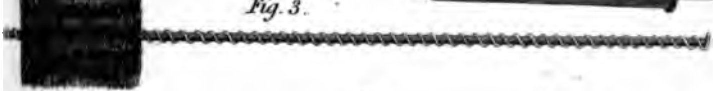

Fig. 3.

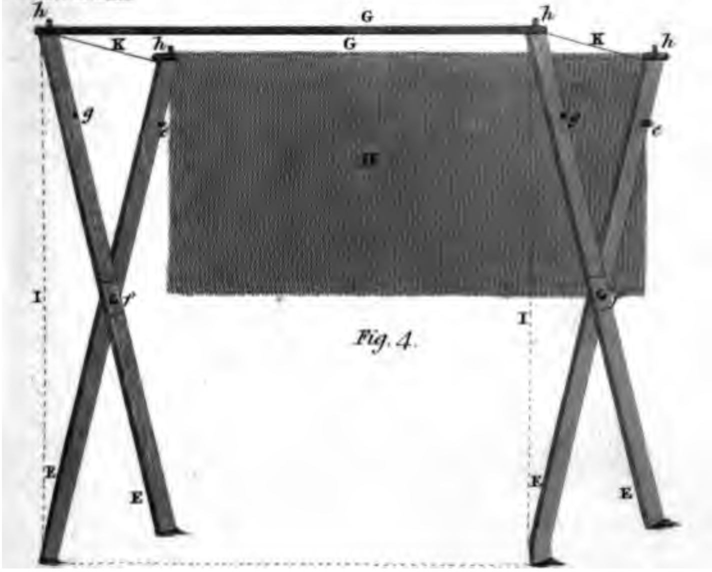

Fig. 4.

suffer our apprentices, or boys employed by us, to seek work, or to be engaged in any way in our business out of doors, after five o'clock in the afternoon in summer, nor after four in winter.

4. That each boy shall have a good breakfast, before he leaves home in a morning, a good dinner between the hours of twelve and two o'clock at noon, and a good supper between the hours of five and seven o'clock in the evening.

5. That every two boys shall be allowed one good bed, with sufficient coverings, and they shall be allowed at least eight hours rest in each night.

6. That we will provide every boy with decent and sufficiently warm clothing, as a sweeping-dress, including a pair of good shoes, to be worn always when he is on duty, also a suitable cap, having a plate in front with his master's name and place of abode engraven on it.

7. That over and above the sweeping-dress, we will provide for each boy a complete suit of good clothes, including linen, hat, shoes, and stockings, on every Easter Sunday, and that he shall appear in the same before "the Committee for bettering the Condition of Climbing-boys, &c." on the Monday following, between the hours of twelve and one o'clock, at the Cutlers' Hall, or some other convenient place, and shall be permitted to dine there, or elsewhere, on that day at the Committee's expense.

8. That we will not, on any occasion, lend out our boys to each other, or to any other persons in the trade.

9. That we do engage, on every Lord's day, to send our apprentices and boys employed by us to some Sunday-school approved by the aforesaid Committee, and

also to divine service with the rest of the children who attend the same school.

Samuel Roberts,
T. A. Ward,
G. Bennet,
W. Younge,
C. Pukslay,
J. Montgomery,
Michael Mellon, his ✕ mark,
George Rippon, his ✕ mark,
William Pears, his ✕ mark,
John Rodgers,
John Betts.

Reference to the Engraving.

The two brushes, Figs. 1 and 2, (Plate III.) are those which at present appear to answer best the intended purpose. Fig. 1 is the easiest to work in difficult chimneys, but in those which are tolerably straight No. 2 will be found the more convenient, as it clears itself better of the soot in ascending. Soldered on the inside of the iron hoop A, at *b* is a hollow iron tube, going through the wood balls B. The nut C screws upon the upper end of the hollow tube, through which the rope passes and fastens the whole together. The balls B are put upon the tube in separate parts, divided at *d*, for the conveniency of putting in and replacing the brush part F, which is composed of bristles, whisk, and whalebone. The whisk (which should be well selected for the purpose) is in the middle, on each side of which, above and below, is a row of whalebone, split thin, with the flat sides towards the whisk, and above and below the whalebone are bristles. Care must be taken that the whole is not too thick and strong, otherwise it will be difficult to get in and out of the pipes on the tops of the chimneys; where they are pressed together between the balls B, they should not be thicker than three-eighths of an inch. Great care must also be taken that the parts of the brushes are well fastened together, and firmly fixed between the balls B, so as not to be loosened in working. The diameter of the balls B is three inches. The distance between the two brushes F F, in drawing Fig. 2, is about four inches. The wood tubes D, (which are about one inch in diameter,) through which the rope passes, should not be too long; the shortest next the brush should not exceed fifteen inches. They should gradually increase in length as they recede from the brush to the bottom, where they should not exceed thirty inches. The brush, Fig. 3, is a good deal similar to a bottle-brush, the handle about four feet long, made of whalebone, wrapped with iron or brass wire, the brush part made of bristles only. It will be found to be very useful in cleaning short flues, &c. in kitchen-chimneys. Fig. 4, is a kind of tent, within which the machine may be worked. It will be found useful in rooms, where it is particularly desirable to prevent the least particle of soot from escaping. The cross bars E are of oak, about one inch and a half broad, and half an inch thick, turning upon an iron pin at *f*. G G are two small iron rods, slipping upon pegs at *h*, to each of which is suspended a linen curtain, the one next the chimney H, a short one, the other as shown by the dotted line I, a long one, reaching to and resting five or six inches upon the floor. *e e* are small pegs, which when the bars E are closed, fit into the notches *g g*, so as to stop the bars in the proper place, and prevent their being opened the wrong way. When the bars E are opened, they stretch the tapes K, which are fastened to the tops of the bars at *h*, and are about three feet six inches long, to which extent only they suffer the bars to open. When this ex-

extended, and placed in the proper situation, a loose sheet, of the same kind of linen as the curtains, is thrown over, and hangs down over the tapes and upon the floor at each end, buttoning to the curtains at the corners, so as to form a complete tent, about five feet long, four feet wide, and five feet high, within which both the man and the boy can stand with the machine to work it.

On Seed Grain.

By the Right Honourable Sir JOSEPH BANKS.

From the COMMUNICATIONS to the BOARD OF AGRICULTURE.

THERE are few subjects on which the attention of this useful Institution can be more advantageously employed in the service of the public, than in discussing the question, whether the corn and pulse, usually separated from the rest because it is lean and small in size, and consequently less marketable than well filled and plump grain, is not quite as proper for seed, as fully endowed with the qualities of its parent corn, and as likely to produce corn of a superior sample, as its lusty and plump brethren of the same ears, which are so much more acceptable to the miller, the housekeeper, and every kind of consumer.

A number of well informed and active men have most [illegible] at present [illegible] a contrary language; those who at present gain, by receiving from their neighbours an extravagant price for seed corn of the most useful quality; the evidence of such persons should not be admitted without caution; in truth all evidence on a matter so important to the public welfare ought to be received with circumspection, and examined with severity.

If we admit the increase usually derived from the cultivation of wheat to be fourteen times the amount of the seed sown, we must also agree that one fourteenth part of the very choicest of the produce of every good harvest is annually committed to the earth; and in years of dearth, when speculators increase the breadth of their wheat crop, a still larger proportion; should experiment decide that we may safely substitute in the place of this valuable article, the small grains that are now generally destined to the rearing of poultry, the gain of the public will be immense, and the loss scarce sensible; poultry is the food of the rich; it may, and will be maintained upon potatoes, if unsaleable corn can no longer be procured; nor does it matter, in point of internal policy, whether a chicken costs three shillings or six; while no consideration so intimately involves in itself the future destiny of the country as the necessity of securing, by every measure the sagacity of man can devise, a sufficient supply of farinaceous food for the whole population of the country, at a reasonable and adequate price.

Thus much having been premised, an example will be given of the perfect success of sowing pulse of the very leanest, and most shrivelled quality; the correctness of which may be easily inquired into, and will bear the strictest investigation. It is to be hoped that other examples of the success, or of the failure, if such there are, of similar experiments, will be communicated to the public by some respectable channels, and the means of investigating the correctness of each statement be afforded, by a distinct communication of the names and addresses of the parties concerned.

The year 1807 was, as we all know, a calamitous season for peas; the crop was in a manner wholly destroyed by a small green aphis; similar, except in its colour, to the black aphis called the collier, which in dry seasons is very mischievous to the beans.

The Earl of Winchelsea had that year, at his Lordship's farm at Burley, 12 acres of land sown with pearl peas; the crop was nine bushels; a peck and a half only of shrivelled and unsaleable pulse. In the spring of 1808, his Lordship ordered these lean pease to be dibbled into as much land as they would cover, which measured, when the work was completed in the middle of April, six acres and 13 perches. The crop reaped from this was 25 quarters and four bushels of good boiling peas, weighing 18 stone seven pound a sack, Winchester, or more than four quarters an acre *.

Mr. J. Stimson, Lord Winchelsea's bailiff, at Burley, near Oakham, has his Lordship's orders to answer any inquiries, either by letter or in person, on the subject of this very interesting experiment; no difficulty can therefore occur in satisfying the minds of those who wish to make further inquiry.

To have seeded six acres of land in the usual manner, with the proportion of three bushels and an half to an acre, would have consumed 21 bushels of prime peas, buried, as appears by the success of his Lordship's experiment, utterly in vain; which, if preserved, would have become the food of man in an absolute dearth of

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* Twenty-one quarters of these peas were sold by Mr. Wrench, seedsman, in Lower Thames-street, for Lord Winchelsea, at seven pounds six shillings per quarter.

a species of provisions indispensable for the victualling of our navy: had the practice of sowing shrivelled peas prevailed through the island, and there is no reason to doubt it would have succeeded as well in other counties as it has done in Rutlandshire, a material diminution must have taken place in the last year's prices, by peas, that were actually used for seed, coming to market as boilers; and as many persons who wasted their shrivelled peas in feeding poultry and swine, and were deterred from sowing by the high price of seed, would, in that case, have sown them, and reaped crops from them, as Lord Winchelsea did, the heavy prices we now pay for boiling peas could not certainly have been demanded.

Our worthy President, in his last publication on the blight, &c. produces decisive experiments in favour of the aptness of ill filled grain to answer all the purposes of seed; he states in Appendix, p. 24, that when the mildewed wheat of 1804 was sown, there were no complaints of its not vegetating, or of its producing puny plants; and again, p. 51, that peas, so small that they could scarcely be called by that name, sown in 1808, produced a most plentiful crop of straw and of peas well filled, large, and of an excellent quality. He recommends it (p. 61) as highly proper, to try any suspicious grain in pots previous to its being sown in great quantities; adding, "if good seed could be obtained without difficulty, and at a moderate expense, it certainly "ought to be preferred:" but, at the same time, as he pointedly refers his reader to the remarks of a person, whom he states to be an intelligent farmer, and who strongly recommends in his paper, the superior advantages of well-filled grain for seed, it may not be improper shortly to consider the soundness of his doctrine.

This intelligent farmer takes up the question in page 73, and decides it in a peremptory style; he sowed, as he informs us, in different fields, well-filled seed of the crop of 1806, and lean seed of 1807. From their first appearance the corn from the plump seed was much more luxuriant, and it continued so as if it had been dunged, and the other neglected; he omits, however, to tell us how long the superiority continued, and is wholly silent on the nature of crop produced, either in point of quality or of quantity; to compensate this deficiency, he enters into an argument to prove that *topers*, as he calls them, that is individuals that take the lead of the rest in size, while young, either in the animal or vegetable tribes, never fail to preserve their superiority; and he concludes by informing us, that well-filled seeds are better calculated for pushing in search of nutriment, than grain of a meaner quality.

That corn, which runs to straw, and in consequence is deficient in the produce of grain, overtops the rest, we all know; that grain well filled with farinaceous matter is better calculated to push in search of nourishment than leaner grain, or, rather, that it can continue in search of it longer in case of disappointment, is true, because it carries with it into the ground a greater store of food; it may be therefore preferable for barren and unmanured land; but in well-tilled and rich land the root cannot fail of immediately finding what it is in search of; and after this is effected, the nourishment remaining in the seed corn is superfluous. Nature is, in most cases, prodigal in providing an abundance of nourishment for infant existence; the cow gives milk many months after the calf is able to maintain itself on grass; the ewe has always milk in her udder when the lamb is weaned; we long ago learned to derive advantage from the superfluous milk of the cow, and, in some countries, from that of the sheep; why then should we not avail ourselves of the superfluous nourishment which nature has provided for us in the sleek and weighty grains of corn, which the improved art of tillage enables us to produce? The intelligent farmer, who has voluntarily undertaken the interesting experiment, is certainly, in some degree, called upon to bring it to a conclusion, and to report to the President, in case his crops of this year suffered by the mildew or any other cause, not only the early appearance of future crops, but their final result, both in quantity and quality, properly compared with each other; and this we may fairly expect him to do.

On improving the Manufacture of Gunpowder.

By Mr. L. J. PROUST.

From the JOURNAL DE PHYSIQUE.

THE charcoal obtained from different plants yields, on being burned with nitrate of potash in close vessels, several gases and other products, which are now well known. But if the several mixtures that may be made of salt-petre and different sorts of charcoal are examined in respect to the time that they take up in detonating, results will be obtained which have not yet been noticed; and the case is the same in respect to the detonation of any particular sort of charcoal used in various proportions. These two varieties of combustion produce phenomena which are but little known. They are here noticed because it may contribute to the progress of science, and to the improvement of gunpowder, as they throw a light not only on the choice of the best sort of charcoal, but also on the most proper proportion of that inflammable body in the composition.

The use of the sulphur is not indeed properly investigated; neither as to the proportion which agrees the best with the other ingredients of the powder, nor as to its use in the detonation. For instance, the sulphur does not combine with the oxygen of the salt-petre at the same time with the charcoal, and it is certain that it in reality cannot: so that it still remains to be explained, by what means the sulphur augments the gases, heat, and force of the powder; or rather what are the affinities which cause the sulphur, in the midst of so many products arising from the detonation, to augment the effects of the powder so greatly.

The researches now presented to the public embrace these three points, but as they have not been conducted as far as was expected, they are only fragments. They are indeed the remains of a laborious examination which has been given up, and of which the publication has been delayed for four years because the circumstances that occasioned them no longer exist. It is however to be hoped, that notwithstanding the detached state in which they appear, they will have the merit of being a continuation of those experiments of Lavoisier that remained to be undertaken, in order to clear up the theory of gunpowder, and which chemists have always neglected on account doubtless of the dreadful accidents that struck terror into the most ardent cultivators of chemistry. Nevertheless, although these experiments were a first essay, and that is rarely the most prudent, yet nothing happened to occasion any fear, and they were only stopped in order to be extended hereafter; especially as the author is attached to a corps which renders it his duty to attend to the subject. In reality, where is the professor who, having arrived at that part of his lectures in which he must say something upon gunpowder, has not felt, at least once a year, in an awkward state, on finding himself reduced to the necessity of repeating two or three crude and unsatisfactory opinions with which he is obliged to hide, as much as he can, the immense void that occurs in this part of chemistry. It is easy enough to talk of gunpowder before the generality of mankind, and to amuse them for a minute with it; but it requires much more than a few common place phrases to instruct military men who require a profound knowledge of a subject, which is of more consequence to them than all the other branches of knowledge in which they are usually instructed. These experiments were undertaken in order to prevent this humiliating embarrassment, and the want of fundamental facts; although the whole is far inferior to what it ought to be, it will however afford some capital experiments to teachers of chemistry, which are not only striking in appearance, but equally proper to fill up the chasm left in this part of chemistry. Those also who study the science of artillery will find some observations worthy of their attention, because on the one hand the fundamental facts have been taken from papers which are to be depended upon, and on the other, because there exists some opinions respecting the manner of trying gunpowder, and the estimate of its strength, which it is now more than ever necessary to submit to the judgment of the knowledge of the present day.

The barometer that was employed was divided according to the royal standard foot; but the bell glasses were divided according to the weights, and foot of Burgos, which are rather less than those of France. Why then, it will be asked, were they not reduced to the weights and metre of the empire? To which it may be frankly answered, that it would have been tiresome, and also entirely useless to persons who should be tempted to continue this course of experiments. Would they, in reality, employ Castilian weights and measures? Certainly not. The experiments remain therefore as they were, and yet the proportions between the results will be equally perceptible.

Preparation of the nitro-carbonaceous Mixtures.

Five parts of pulverised and very dry salt-petre is thrown into a large bronze mortar, along with one part of the charcoal it is intended to examine: a few drops of water is then sprinkled on it, and the mixture triturated with an iron pestle for the space of half an hour. Water is then added, but only a little at a time, so as to keep the mixture sufficiently moist to hinder it from flying about. This labour is continued for about six hours; when it is finished, and the mixture appears to be as dry as it can be made by the mere action of the pestle, the powder is withdrawn, wrapped up in a double fold of paper, and placed upon a chafing dish, or in a drying stove. When it is dried, it is essentially necessary to repass it through the mortar for half an hour or less, in order to obtain an impalpable powder, which should be kept in a bottle with a cork.

When it is intended to compare several sorts of charcoal together, it is proper to put all the mixtures a second time in the stove, in order to have them all of the same degree of dryness, and to equalise as far as is possible the circumstances of their preparation. One or two ounces of each of these mixtures are amply sufficient for these experiments, as only a drachm, or thereabouts, is used in each experiment.

It is almost useless to mention, that in order to be certain in respect to the comparison, the different sorts of charcoal ought to be prepared by the chemist himself, or at least that they ought to be heated by him in a retort, before they are employed. At the commencement of these experiments, it was thought absolutely necessary to make the mixture immediately after the charcoal was taken from the fire, in order to avoid any moisture, or those gases which charcoal is well known to absorb during its cooling, and even long afterwards; but it has since been considered, that water itself, and the other foreign ingredients add so many new elements to the force of the gunpowder; it was therefore thought proper to neglect, at least for the present, this labour, as it appeared that the purpose in view would be obtained much sooner by beginning with charcoal in its usual state. In reality, gunpowder for the use of armies will never be manufactured from pure carbone, or any substance nearly approaching to it, but from the hydro-carbonous and complicated composition that is used as fuel in our furnaces. By this means, as great an analogy as can be desired is preserved between gunpowder (which it is intended to submit to a fresh examination), and the mixtures that are to be used, to throw a light upon the phenomena exhibited by it.

After these trials, the others which led the way to them should naturally follow; that is to say, the combustion of mixtures prepared with charcoal purified as much as is possible from other bodies; but the changes that have happened having prevented them from being added, a void occurs, which, however, is but small. Nevertheless, as it relates to a point essentially connected with these researches, it would be very desirable if some other person would take up the repetition of these experiments, especially as the remaining trials necessary to complete this part of the inquiry would not be many. It would only be necessary to mix saltpetre with five or six of the principal sorts of charcoal, taken in the order of the following table, and to observe only their effect as to the manner and duration of their combustion, especially as there is nothing else that requires to be investigated, their other products being well known. Thus there would doubtless be obtained some results that could not but give some farther light on the duration of the combustion of these mixtures, or, in one word, on that property of the different sorts of charcoal which has not hitherto been investigated in a direct manner.

If, however, it is allowable to indulge in conjectures upon the facts already known, the results of these combustions may in some measure be estimated from the present experiments. The different kinds of charcoal which Berthollet, Morveau *, Scheele, and others used in experiments relating to the emission of gas, were no otherwise altered than in their combustibility being very sensibly diminished. Whence it may be judged, that the same change would take place in charcoal prepared for the intended researches. And the same would probably

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* Charcoal exposed to heat imbedded in powder of charcoal, and of course immersed in the gases separated from it, loses much of its ordinary combustibility. *Morveau.*

bly be the case with carbon itself, or, in one word, with that substance which although we can neither see it nor feel it disengaged from other matter, yet is much better known than the charcoal that we use every day. How much knowledge is still wanting before the properties of what is called charcoal can be absolutely determined, or the purity of this combustible body rendered capable of being defined in the same manner as the purity of sulphur, phosphorus, gold, or silver, is determined.

Preparation of the Tubes used for firing the Mixtures.

Tubes half a line thick, three lines in diameter, and two inches and an half, or more, in length, are to be made of brass. They ought to be closed at one end, well soldered without any lumps left on the inside, and perfectly equal in their caliber. They ought to differ only in length; that is to say, they should be sized from two and an half inches to three inches, or even more, in length, increasing only a line in each size. It is also necessary to have three of each size, because there is sometimes two mixtures of the same kind to be fired together; and it is also proper to avoid having any occasion to procure new tubes during a course of experiments. For if the workman who made the first parcel should have mislaid the mandril by which their caliber was regulated, he will run a chance of furnishing others of a different diameter; and then, as the combustions will of course not take place in areas of the same dimension, their duration cannot be compared; so that it will then be necessary to take the resolution of going the whole labour over again with the new tubes.

As the least charge that was used was 72 grains, it is best to ask the workman for the smallest of the tubes, and to try what it will hold, by charging it with the above quantity of materials, after which it may be cut off a line above the charge. This will of course be the first of the series, and the others may be sized from it. It is not certain that the smallest tube used in these experiments was exactly two inches and an half in length; but by this precaution the workman will have no occasion to make repeated trials of their length.

It sometimes happens, that a tube will not hold all the charge intended to be fired in it, because it is, perhaps, three or four lines too short: in this case, it must be lengthened by putting an additional length of tube to the mouth of it. This is to be fastened with a little sealing-wax, and the tare of it added to that of the tube, after which it may be charged as usual. This lengthening of the tube does not alter the exactness of the experiments, for as soon as the mixture has burned down it falls on one side, and is found upon the cork float, hereafter mentioned.

The tubes are charged with a large quill, cut sloping, and the mixture is rammed down with a brass rod, of the same diameter as the tube, and about five inches long. The upper end of this rod should be formed into a ring, that the hand pressing it down may not be incommoded. Plates of lead are also to be cut of the weight of the tubes, in order to have their tare always at hand, which may be adjusted exactly by slips of paper.

It is, moreover, necessary to keep the tubes at the surface of water when they are fired. For this purpose they are placed in a round of cork, half an inch thick, and about two inches in diameter, in which they are to be so fixed that their mouth may not be more that two or three lines above the surface of the cork. This being done, the round of cork and the tube are set to float in a drinking-glass filled with water. By this means, the greatest part of the tube being under the water, the brass is kept cool, and defended against the too great heat, which is still sufficient to make the water that touches the tube hiss; and as it acts in this manner gradually from the mouth to the bottom, the progress of the combustion may be observed by the bubbles which are detached from the tube.

When every thing is got ready, as above mentioned, the experiments may be proceeded upon in the following manner.

Being seated before a table, the glass and its floating apparatus is to be placed opposite to a pendulum that swings seconds; the mixture is to be set on fire at the instant when the ball begins its oscillation, and the first second is to be reckoned only when the ball begins to retrace its former steps. To succeed, however, in reckoning the time, it is necessary to perform a kind of exercise before-hand, by firing half a dozen mixtures without any other object. By which means the surprise that is always felt when a fusée is fired may be got over, and then a person can make the firing of the mixture exactly coincident with the instant that the ball of the pendulum begins to descend. Besides this, if the pendulum swings in a quadrant with divisions like those of Mr. Pierre Leroy, the eye can easily distinguish halves or quarters of seconds, if it should be thought necessary to examine the duration of the combustion to that exactness. If there should be any doubt as to the number of vibrations, the trials ought to be repeated two or three times.

For the purposes of priming the mixtures, a small quantity of the best gunpowder, finely pulverised, is to be put upon the mixture at the mouth of the tube, where a void space of a line in depth is always to be left. This is fired by the burning point of a match, or which is the most commodious with the point of those artillery fire-sticks that the author first made known in 1790. As the priming is consumed in the twinkling of an eye, it is easy to be perceived that it does not lengthen the duration of the combustion.

A tube is charged with seventy-two grains of mixture; at first a spoonful of the mixture is put into it, and rammed down with the rod: the lower end of the tube is then struck two or three times against the table with the right hand, while the rammer is pressed down with the left. A second spoonful is then put in, and this is continued until it is filled to within a line of its mouth. With a little practice, the force of the strokes and the pressure may be so regulated, that a given weight of mixture will always fill the tube to the same height. A circumstance which shews that the ramming, however variable it may be, does not influence the duration of the combustion is, that it never varies a quarter of a second if the weighing of the mixture was made with care.

And as there is a very remarkable coincidence between the duration of the combustion and the weight of the residuum left in the tubes, the weighing of them ought not to be neglected. It is this weight that is noticed in the following table, in the column that is placed next to the times. It must not, however, be thought that this weight answers exactly to the real residuum of the sixty grains of saltpetre that is used; for it is easy to be perceived that the force of the detonation always throws out a large portion of it. But in general the remainder is considerable when the combustion has lasted a long time. The gas from a sluggish detonation being emitted with less force than that from a violent and hasty one, is not able to throw out with such violence the residuum, which of itself is not of a nature to retain for any length of time the vaporous state. It is, indeed, a well known fact among sportsmen, that the longer time gunpowder takes to be consumed on the piece of paper upon which they are accustomed to try it, so much the weaker do they judge it to be, and so much the more does it foul their guns.

Table of those Kinds of Charcoal, the Mixtures of which will burn in the Tubes.

	Saltpetre, 60 *Grains.* *Charcoal*, 12 *Grains.*	Time of burning. Seconds.	Weight of Residuum. Grains.
1.	Charcoal of sugar	70	48
2.	—— of fossil coal, or coak	50	45
3.	—— of Indian corn, or maize	55	43
4.	—— of alkohol, by three parts of sulphuric acid, and heated to redness	36	44
5.	—— of walnut-tree wood	29	33
6.	—— of chesnut wood	26	36
7.	—— of the stalks of maize	25	38
8.	—— of the stalks of pimento	25	36
9.	—— of hazel wood	23	30
10.	—— of spindle-tree wood	21	27
11.	—— of bourdeine	20	24
12.	—— of fir, or deal	17	30
13.	—— of the stalks of chick-peas	13	21
14.	—— of vine-twigs	12	20
15.	—— of hemp-stalks, peeled	10	12
16.	—— of the stalks of asphodel lillies	10	12

Mixtures which will not burn in the Tubes.

Charcoal of starch.
—— of wheat.
—— of rice.
—— of nutgalls.
—— of guaiacum.
—— of heath.

Charcoal of indigo.
—— of wheat gluten.
—— of glue.
—— of white of egg.
—— of human blood.
—— of tanned leather.

Let us now proceed to the detail of the several comparisons that these results afford.

The combustion at the head of the table is, doubtless, the most astonishing, that twelve grains of charcoal made from sugar should require no less than seventy seconds to be consumed by means of condensed oxygen. It is even certain the real quantity actually consumed is not of that weight; for it will hereafter be seen, that five parts of saltpetre are not sufficient to burn one part of any kind of charcoal whatever.

The same may be said of the charcoal of alcohol, of that secondary product to which sugar, during the phenomena of fermentation, only yields its own proper substance by means of the inversions that it undergoes. Assuredly, it could never be expected that a charcoal sufficiently dense or close in respect to the adhesion of its molecules to resist for a long time the active force of ignited oxygen should be yielded by sugar, or one of the most simple immediate products that is known in the economy of vegetables. Does it not seem, on the contrary, that if charcoal eminently combustible was desired to be obtained, it would be found among the least complicated products, among those in which vegetation had not associated elements, such as azote, or some others, which are only proper to diminish the combustibility;

bility; and again, as charcoal of sugar cannot be consumed in less than seventy seconds, how comes it that the charcoal of alcohol is burned in half the time.

Starch, another product no less simple than sugar in respect to the number and arrangement of its principles, especially if it is carefully purged of gluten, yields a charcoal that is still more difficult to burn. Its languishing detonation is smothered by the potash that is formed. The case is the same with all those kinds of charcoal that are quoted in the second table. The combustion is in general without any force, so that they cannot be brought into any comparison with the former, at least unless the combustion was repeated, as it was intended, in tubes of six or seven lines in diameter. Besides, what is the true character of pure charcoal? This is at present unknown. Those kinds that are the farthest removed from combustibility, are they those which are the nearest to that type of which chemistry is in search? The charcoal of wax, oil, resins, &c. was intended to have been included in this table; and if any person should continue these experiments, they cannot avoid discovering some useful facts in this series.

The chesnut-tree, whose charcoal requires twenty-six seconds to be consumed, or rather the wood of it, has received from nature a peculiar quality, which renders it very valuable in those countries where it is plentiful. It is here mentioned, because it does not seem to be so generally known as it ought to be.

In the Asturias, a province as rich, by the fruitfulness of its soil, as it is enchanting, by its picturesque views, which are worthy the pencil of Casas, the chesnut is sometimes used for fuel. If a brand of it is taken from the fire, it is seen, not without some surprise, that it is extinguished as rapidly in the open air as if it was plunged into carbonic acid gas; this happens so quickly that a pipe cannot be lighted by it. It is probably this difficult combustibility that occasions its being preferred for floors, which are there scarcely ever tiled. In all the houses the floors are brought so near the fire-place, that one is astonished at the security of the inhabitants; but one soon becomes as indifferent as they are in this respect, when it is observed, that if any burning wood happens to fall on the floor there is no more danger than if it fell upon tiles. A plank will at the utmost be scorched, but there is no risk, as in other kinds of timber, of the house being set on fire.

It is also from the nature of chesnut charcoal that this kind of fuel is preferred in forges. Take the hands from the bellows, and it begins to go out; its consumption is thus husbanded while the workman is at the anvil.

The following fact merits a place in the history of the unhappy inhabitants of these charming plains. A few workmen came from Guipazcoa in order to establish themselves at Oviedo, and manufacture guns for the government. They required all the chesnut charcoal that they wanted should be delivered to them at a low price. A barbarous carelessness agreed to this strange bargain, at the very mouth of the richest coal mines. By this means the Asturians were reduced to deplore the daily felling of a tree that supported them when the crop of maize failed; and ten years of representations to ask that fossil coal should be substituted for the other were not sufficient to obtain the abolition of this horrible contract. You wanted, generous Asturians, a protecting authority. You, who opened your arms to all those unfortunate persons with which a dreadful proscription inundated your plains. This elysium of Spain, where Philip II. found almost all the timber that was used in building his formidable but unfortunate Armada, has long been neglected.

Economy has suggested the use of heath charcoal, or that of its roots, to the iron-masters of Castille. It ceases to burn as soon as the bellows ceases to blow. The centre of Spain has not any coal mines, as in the Asturias, Estramadura, Andalusia, Catalonia, &c. They have been searched for in vain throughout the provinces which surround Madrid; nothing but a few veins of a bastard kind of jet, without any good qualities, have been found.

Proceeding upon the supposition, that azote, which is contained in so many kinds of charcoal, might cause the incombustibily that characterises some of them, it was thought proper to treat several sorts with potash, if it were only to observe what effect this operation would have upon their combustibility, in case that principle should not be found in them. The following results were obtained from several kinds of charcoal, as well vegetable as animal.

Chesnut-wood charcoal, treated first with potash and then with a dilute acid, in order to cleanse it from a quantity of soluble ashes, became more combustible than before; for instead of requiring twenty-six seconds, it took no more than sixteen to detonate with five parts of saltpetre. Nevertheless, no traces of prussic acid could be discovered in the ley, which is astonishing.

Charcoal made of heath also became improved by this mode of treatment. It was tried with saltpetre, but the note either cannot be found or the increase of combustibility was omitted to be stated: however, it yielded no traces of any prussiate.

Indigo charcoal yielded a considerable quantity of prussiate. A second application of the alkali did not extract any additional quantity. The residuum was not observed to have acquired an increase of combustibility.

Two successive operations made upon the coak formed from some excellent coal, dug at Villa nueva del Rio, near Seville, caused a diminution of its combustibility. The first ley contained a prussiate, but not the second.

Some fine anthracite, which burned with great difficulty without any flame or odorous vapour, yielded evident traces of prussic acid. It is probable, therefore, that it derived its origin from fossil coal. This anthracite was found very near the monastery of Harbas, at a little distance from the pass which leads to Oviedo through the beautiful valley of Campomanes.

TO BE CONCLUDED IN OUR NEXT.

List of Patents for Inventions, &c.

(Continued from Vol. XVII. Page 384.)

THOMAS MANN, of Bradford, in the county of York, Stuff Merchant; for certain improvements in the construction of artificial legs. Dated October 31, 1810. Specification to be enrolled within two months.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CIV. SECOND SERIES. Jan. 1811.

Specification of the Patent granted to Joseph Bramah, *of Pimlico, in the County of Middlesex, Engineer; for a Method of making and constructing Pens for writing with.* Dated September 23, 1809.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said Joseph Bramah do hereby declare that my said invention is particularly described and ascertained as follows; that is to say: I do not rest my claim to novelty or excellence in this invention solely on my having produced by this my said invention pens either superior in their component quality or effect when used to write with, but the superior merits and advantages derivable therefrom depend on the following particulars, and are performed as hereunder described, namely.

First. I take the quill of a swan, goose, or any bird of which pens can or have been made; and after having cut off the point, to prepare for slitting, in the usual way, I then sever the barrel of the quill from its top as near the feather part as the nature of the quill will admit, for making a clear and proper slit at the upper end as well as the extreme point usually made into a pen. I then slit by a knife, or other proper instrument, both ends of the said barrel of the quill, and make at each a complete pen, so that I can by this means produce two ready-made pens instead of one out of one quill, which will promote in favour of those departments where they do not cut or mend their pens, not only the considerable saving of one moiety of the whole consumption, but add facility to business, because I mean to adapt as a handle to these pens for common use, nothing more than a straight round stick, which, being a little taper at the extremity below the hand, may be readily inserted into the cylindrical part of the quill which is left whole between the two pen points, as above described; by this means the pen when worn and blunted by use at one end, can in an instant be withdrawn from the stick and the other end applied. These I call the first class of compound pens; and in some instances I mean to prepare the aforesaid sticks or handles with a taper point, as above described, at both ends, so that by fixing a single compound pen at each end four complete pens will be produced, which can both be instantly reversed, as before, as they become dull, and by which property both convenience and facility will be gained of great importance in many instances of penmanship and business; and which latter sort, with four points on one handle, I call double compound pens.

Second. In order to produce the greatest possible saving in the present expensive article of quills, I take them of all sizes, as they may come to hand, and after having cut off the extreme point, and severed every barrel from the top, as in the former instance, I take and divide the barrel from one end to the other, longitudinally, by means of a proper cutting instrument, exactly into two half cylindrical parts, and by this means I save one half of every quill, being that part which is always wasted by the knife in making pens the common way, and consequently I have two quills, or parts of quills, equally competent to produce pens with only a little less in the quality of the belly part of some quills. These half quills being thus prepared, I make, as in the first section, a pen at each end of both the said half quills, by which means I produce at once four pens out of one quill, of equal utility to those made from whole quills in the usual way. These pens I denominate treble compound pens, and I mount them for use on sticks, as before, either at one or both ends. These sticks are formed precisely similar to those already described; a little taper at one or both ends, and to one or both of which taper ends I slip on a socket, made either of the barrel of a quill, silver or other metal, and which socket is a little taper also, and made to fit the stick so as to admit it (being first rounded off at the end) to project before the extremity of the socket about one-eighth of an inch, so that when the stick or handle is withdrawn a little out of the socket an interstice is made between the socket and the stick of the thickness of a quill's substance; then the pen, consisting of the half quill as before, being put into the socket with a proper projection of the point before it, and the stick, being forced forward, will, by its taper form, completely fasten in the pen, and render it fit for use with the projecting point; and which point, when dulled by use, may, by withdrawing the stick, as above described, be replaced by the pen at the other end, and thus by one quill instead of two, as in the first section, the same benefit and convenience is produced.

Third. In order to make a farther saving, not only in the article of quills but also in facilitating business, I take and divide quills longitudinally, as before, not only into halves, but in some cases, and according to the size of the quill, into three, and even four parts; and when this is done, I again divide these parts into lengths, and cut them transversely into two, three, four, and some into five lengths, according to the ultimate dimensions or lengths of the different sized quills. I then make, as before, a pen at each extremity of these lengths, some for large and others for small hand, at discretion; and by this means I am able to produce out of the smallest sized quills eight pens, out of others twelve, and from that to thirty (and from swan quills even more) complete pens, for small hand, drawing, and other purposes, equal in both goodness and durability to those produced out of whole quills. These pens last described I call fragment pens; and I mean to mount them on handles for common use in the manner described in section the second. But when they are mounted so as to be carried in the pocket, I mean to handle them variously, either with brass or otherwise; and as they may be mounted or handled almost an infinite variety of ways, without either advantage or the contrary, I rest no merit, or propose any claim, on whatever method I may in this branch of the manufacture think it proper to adopt.

Fourth. In order to facilitate the fabrication of these pens, and to give them such a degree of truth and regular

goodness in their formation as is unattainable by
e of pen-knives, or any other kind of instrument
fore adopted as a substitute for cutting them by
I take two pieces of steel, of a scantling size, of
three-eighths of an inch by two-eighths, and of
one inch or inch and a half in length, as I think
essary. These I fix in a frame by the side of each
having between them, on the two of their broadest
a thin piece of steel, of the same size in its width,
out the thickness, of a fine watch-spring, and in
gth considerably above the length of the two be-
nentioned pieces between which it is fixed, this I
e lancet, or that part of the intended apparatus or
ne which cuts the slit, and lets down the ink in the
of every pen, and the point, or cutting ex-
y, is made of a shape I find best to answer in prac-
nd is sharpened with an edge both as thin and
r in the middle of the flat substance as possible;
se on this regularity and thinness depends both the
ss of the slit and its centrical adjustment in the
point. When these component parts are properly
curately fitted to each other, by filing, grinding,
n those sides in contact, and also fitted into a
, in which they are fastened by a screw, so calcu-
as to either fasten, or occasionally release them,
re then ready to receive their proper form on those
r extremities meant to act, and form the pen's
; to effect which, these ends of the scantling
are filed upon the bevel, or diverging from each
on the inside, so as to form an open mouth, to the
t in length up the pieces to any distance which
be found necessary for the intended purpose; so
hen these pieces are again brought into contact

on the fitting sides as before, the mouth formed will be of a triangular shape, which, when sloped or sharpened off on the backside, will exactly represent what is called a parting tool for carving and engraving of wood. These pieces of steel are then hardened, and properly tempered, so as to be capable of receiving and retaining a sharp cutting edge, and when that is done they are fit for use. The other thin piece of steel above described, and termed the lancet, is also sharpened in a proper form, like a chissel, or otherwise, as will best answer, and then put into its place between the scantling pieces, as before described, having the extremity of its blunted end above the top ends of the side pieces between which the said lancet is confined, so that when the whole is fixed, as before stated, in the frame, and fastened with the screw, the lancet can be tapped down with a hammer at pleasure, and rendered capable of a nice and accurate adjustment when applied to use. This method of fixing the lancet between those pieces, which cuts the chaps and forms the mouth of the pen on each side of the slit, is of great consequence, and it must always cause both the chaps of the pen's point to be exactly equal in width from the slit. This frame and pieces, as above, being thus mounted and equipped, the whole is fixed or connected to the slider or ram of a small fly-press, such as is used for cutting and stamping in the common way of other manufactures, and which I need not therefore describe. This being done, I place under the lower or cutting point of the instrument a piece of very hard wood or metal, which is made on its upper surface, facing the cutting tool, of a shape either concave or convex, like a reed or a flute, to receive the half or a segment of the quill, either with the concave or convex side uppermost, as I may find it best in practice. This I call the bed or anvil on which the quill is laid when in the act of being cut and shaped into a pen, and which bed or anvil is cut, or receives its counter shape, so as to exactly correspond and fit the cutting part, as above, by a blow or cutting stroke made by the instrument itself, so that there cannot be the smallest error in their contact when in use, and which properly will cause a clear and not a ragged cut always to be made upon the quill. This bed or anvil is also fixed and held in its place by being driven tight into a horizontal groove in the bed of a cutting press; so that when the contact with the cutting tool shall slacken and become blunt with use, a small blow made by a hammer, or being forced towards the cutter a little by a regulating screw, the next blow or cut made by the press will renew the contact, and make good this defect; and by this means, added to the ready manner in which the pieces of steel which form the mouth and the lancet also may be sharpened when taken out of the frame, the engine can be continually kept in a state of perfection with a little trouble. When the apparatus is thus equipped for action, and the ram or slider of the cutting press has been limited to its motions, by a proper stop, the lancet may be so adjusted by the tapping of a small hammer as to just cut through the thickness of the substance of the quill, and no farther; and it must be here observed, that the ends of the pieces which cut and form the shape of the pen must be as much-shaped upon the bevel as to cause the operation of the cut to finish at the point of the pen, and not at the shoulders of the point, because in the latter case the point of the lancet would have of necessity to pass as far beyond the thickness of the quill as the extra motion for finishing the mouth would require, and by which the two chaps of the pen would be distended by the thickness of the lancet's taper form, and consequently receive such a false cut as to leave the chaps with a hair point each. In making pens by this instrument I do not mean in general to nib or cut the point square and clean by the operation of cutting the mouth and producing the capillary slit, but I intend rather, when the parts of divided quills, as above described, are cut into lengths, they shall be cut both square and clean enough to answer for the point; and in which case it must be obvious, that by forcing the quill when in the operation of forming the pen a little more or less near the junction of the triangular mouth of the cutters, the width of the pen's point will consequently be increased or diminished in its dimensions, so that by a nice adjustment in this respect I shall be able to cut the point broader or narrower at pleasure; and by so doing I can cut pens, calculated for every kind of hand, with strict accuracy; and also by canting the bed or anvil on which the quill rests, either to the right or left from a right angle with the centre of the cutter, I can form pens with points a little out of the square, either way, for such as are used for ingrossing, and other particular purposes.

Fifthly. I now come to describe what I conceive to be as important a part of this invention as any of the foregoing, and on which its utility and public benefits will superiorly depend; namely, a property which enables me to use those pens without the assistance of an inkstand, or any other vessel to contain ink in the usual way, and by which not only the time lost in dipping the pen, a waste of ink by the improper dispersion of it

wi

will be avoided, but the ink will in all seasons, by being excluded from any contact with the outward air, be preserved in its most perfect and pure state, notwithstanding it may be ever so long kept in either hot or cold climates; and as the ink by this contrivance is always equally portable with the pen, it will afford uncommon convenience and utility to all those professions and avocations where pens and ink are necessary to be carried for the purpose of immediate use. This property I produce as follows; that is to say, instead of using the common stick, or other methods of handling those pens, as above described, I take a hollow tube, of silver, or any other metal or materials proper for the purpose, and these tubes being made taper at the lower end, and closed in a round or domical form, will effect the office of the stick, as aforesaid. I then fix the pen, (by means of a socket made to fit as before,) of whatever class it may be formed, according to the rules already described. I then make a small perforation in any part of the tube, or hollow stick, a little distance from the point, so that when it is turned towards the centre of the pen the ink may be let down into the mouth. I then take this hollow handle, which is the substitute for the stick, as aforesaid, and its upper end being open and unstopped, I pour it full of ink, taking care to stop with the finger the capillary opening at the lower end, as above described, and when full I stop, and make airtight, with a cork, cap, or otherwise, the upper end, and thus I have this tube, of whatever length and dimensions it may be, completely filled with ink; but which ink, on account of the air-tight state of the tube or vessel, as above, will not, on being turned with its small end downwards, in a position to write, discharge even the smallest portion of the ink into the pen; but in order that those who use the pen may cause it to receive a proper supply, I cause these cylinders or hollow tubes, as aforesaid, to be made so thin as to be readily compressed out of a circular shape by a small pressure between the thumb and fingers which hold the pen, so that whenever this necessary pressure takes place, the tube being lessened in its areal dimensions, the ink consequently is compelled to ooze out of the small capillary opening at the lower end into the pen, so that by a greater or more moderate pressure of the fingers, as above, the pen will receive a greater or less charge at pleasure, just in the same proportion, and thus the act of writing may unceasingly be continued till all the ink contained in the cylindrical handle is exhausted, let that quantity be more or less. And I have proved by experience, that a tube sufficient to form a moderate sized handle to the pen, will, when filled with ink, supply those who write the most constant, and with the smallest intermission, for at least a whole day; and many who write but little, may even perform a long time with such a charge, and by making a ball at the upper extremity, or in any other part of this handle, the capacity for holding ink may be extended to any quantity within the limits of convenience in the instrument; and to whatever this quantity may amount, the pen may be incessantly written with until the whole of this ink is exhausted. Instead of discharging the ink from the fountain down to the pen by compressing the tube or hollow handle, as already stated, I intend, in some instances, to use instead of a cork, or any other kind of stationary stopper at the upper end, a sliding piston, like that of a small forcing pump, and which piston may be slided down the interior of the tube to force down the ink to the pen by the hand or screw, &c. &c. It is necessary for me to observe here, that after a portion of the ink contained in the hollow handle, as aforesaid, has been exhausted by writing with on the compressing principle, and not having any influx of air to supply the space generated by the loss of ink, the pressure for disgorging it will become of necessity increased; but to remedy this defect, when necessary, nothing more is required than to turn the pen with its handle downwards, and by which means as much air will be instantly drawn into the ink cavity, at the capillary aperture, as will restore the balance of the medium that had been destroyed by the exuding of the ink, as above stated. These I denominate compound fountain pens.

Sixth. In order to give all kind of common pens the property of those last described, that is to say, the fountain or perpetual writing principle, I take any common pen, made of a good quill, which is air-tight in the barrel; and if the quill be too hard in its cylindrical texture to be easily compressed by the fingers, as described in the foregoing section; in that case, scrape or shave off the front where the thumb in holding the pen rests, and make it by this operation so thin that the end of the thumb will by a little more than the necessary force for holding the pen, cause that part of the quill to be changed from a cylindrical form to an oval, or other oblate figure, already described; and when this is done I take a small cork, or bit of round stick, or any other substance calculated to operate as a stopper, and which I force into the open end of the pen above the mouth, leaving such a projection into the mouth as will admit of this stopper to be withdrawn at pleasure by the point of a knife, or otherwise; when this is done I then make in the part of this stopper, which falls in contact with the back of the pen above the slit, a small groove, not larger in dimensions than the smallest pin hole, longitudinally along the surface of the stopper, so as to cause the smallest channel possible for the conveyance of the ink down to the mouth when the barrel of the quill is pressed, as above described. When this is done the pen is completed, and ready for action. I then, out of a small bottle, or otherwise, take and fill with ink the whole barrel of the quill, leaving only room enough to prevent the stopper from falling in contact with the ink when forced into its place. The pen is now prepared to write; and then, by pressing the quill, as above directed, I cause as much ink to exude through the small channel as will charge the pen; and I find that such is the ease and convenience with which this can be performed, that I even can supply the pen in half the time necessary for passing the pen from the end of the line finished to begin another; and what adds to the farther excellence of these pens is, I can let down at pleasure either the smallest possible portion of ink, or as easily totally fill the pen's mouth; and it must be at the same time obvious, that not the smallest portion of this ink in either of the above cases can be carried on to the external side of the pen's point, which is always the case when the pens are dipped into a stand, and by which the fingers of the writer are always smeared without the greatest care.

Seventh, and last. In order to complete this important system of writing, and render it as beneficial as possible, I have adopted, for the use of all public offices, the law, and all other stationary situations where writing is performed,

formed, such a principle of supply for each person so employed as will enable them to write for any length of time with one charge of the fountain without ceasing for a single moment, or even finding in any climate the smallest inconvenience from the usual failure and variation in the quality of the ink. I mean, in some instances, where a number of persons are employed to write in stationed situations, and where the method will apply to supply a plurality of writing-desks with ink from one general reservoir, which may be of any dimensions as the case may require, and placed on a shelf, or other elevated situation, of sufficient altitude above the desks to cause the ink to be easily conveyed, by a small descending main, down to each stationary desk, just as water is directed into the different parts of houses for domestic purposes; and into which main I insert a very small cock, at which each writer can fill the hollow fountain or handle of his pen at pleasure when exhausted of its ink, according to the methods before described. And I also mean, in some instances, to join to these cocks a very small flexible tube, (made of leather, or other materials fit for the purpose,) by a screw, similar to that of the hose pipes of a fire-engine; and these tubes I make of a sufficient length to amply reach any point of such desk where the pen of each writer may be called upon to operate on books or otherwise. I then cause the lower end of this flexible tube, as aforesaid, to be joined to the upper extremity, or top of the hollow handle of the pens, by a screw, just like the brass nozzle of a fire-engine, out of which the *jet d'eau* issues when throwing water. When this is done, by opening the small cock above mentioned, the pen will always fill: and when the cock is shut again, the ink will not run out at the capillary opening into the mouth of the pen without some extra force, as in these instances above described, namely, that of moving down the stopper, or compressing the tube or handle out of a circular shape. This effect I produce, in the present instance, by compressing between the fingers any part of the small flexible tube above mentioned, between the stop cock and the pen's top; and by which pressure the mouth of the pen will be charged to a greater or less degree at the pleasure of the writer, and by this means, and a sufficient constant supply of ink in the main reservoir, the act of writing may be unremittingly continued for any length of time. When I mention that the above small tubes must be flexible, I do not mean that they are to be so soft or pliable in their diametrical texture or strength, as to be pressed out of a circular shape, or collapsed by the pressure of the atmosphere, because in that case the ink would spontaneously be discharged down into the pen, and therefore, in order that they may resist this pressure as aforesaid, I take a long slip of thin calf or other leather, cut parallel, and of a sufficient width to wrap round a small wire, which I apply as a mandrill, (say about one-eighth of an inch in diameter,) and of any length I please, with as much overplus leather as will when both the edges are thinned in cutting, so as to over-reach each other when turned round the mandrill to form a splice. I then, while the wire mandrill is in, join this splice or junction-seam of the leather with glue or glutinous gum, &c. so as to form the tube intended; and after which I take and wrap the exterior part of the tube with small wire, or well-twisted thread, from one end to the other, just in the same manner as the bass strings of any wire instrument in music;

and by this means, although flexible in their length, they are diametrically stout enough to resist the atmospheric pressure as above proposed, and yet flexible enough to yield to the extra pressure of the fingers used for the purpose of letting down the ink into the pen. Instead of using leather to fabricate these tubes, I mean sometimes to substitute parchment, prepared paper, or any other substance I may find in practice to answer best, and in which instance these materials may make several folds or revolutions round the wire mandrill, and then be wrapped with thread or wire as before; and, in both instances, when the tube is thus finished and completely dry, the mandrill must be withdrawn, leaving in its absence the tubical hollow space required. I mean in some instances, instead of the methods above described for letting down the ink from the hollow handle or tube into the pen, to make a small perforation, for the admission of air, in the upper extremity of the said handle or tube, and which perforation I stop or unstop by means of a small valve, slide, or otherwise, so that when open the ink will descend, and charge the pen at pleasure; and when stopped it will be prevented.

In witness whereof, &c.

Specification of the Patent granted to DAVID MEADE RANDOLPH, *a Citizen of Virginia, in the United States of America, but at present residing near Golden-square, in the County of Middlesex, Merchant; for a Method of manufacturing all Kinds of Boots, Shoes, and other Articles, by Means of a Substitute for Thread made of Hemp, Flax, or other Yarns. Communicated to him by a Person residing abroad.*

Dated February 21, 1809.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said David Meade Randolph do hereby declare the manner in which the said invention is to be carried into effect and practice, is as hereafter described. And, first, it is to be understood, that this substitute is applicable only to the soles and heels of boots and shoes, as all the other parts of the work is performed in the usual way and manner. The last used for this purpose, and so essential a part of it claims a prior and particular description, the common shaped wooden one being first taken, after proper adjustment, in the ordinary method, is to be sheathed or covered at the lower part or bottom with a plate or sole of iron, or any other fit metal, of about the thickness of a stout leather sole, as in the usual way; and after being suitably prepared and formed for the purpose, it is to be attached to the bottom of the said wooden last, and there properly secured and fastened. As the substitute here alluded to is little nails, brads, springs or sacks, formed or made of copper, iron, steel, or other proper metals, of such lengths as will allow them to reach and perforate the inner sole with which the metal sole is in close contact; and when having been driven, they must, from the resistance, be clinched or rivetted through the leather, and serve instead of sewing or stitching now in use. This, in like manner, is to be substituted and employed in all cases where the other has been found necessary. At the same time it should be observed, that in its application this new method is not limited to the edge or margin of the sole, to which the former method was necessarily confined, but can as easily and advantageously be performed at any intermediate space or part where strength and durability may be deemed requisite, as must appear obviously from the nature of the last. The only difference of which, with the common one, and the additional sole already described, being in form and shape precisely alike, is, that in this sole there are three round holes formed of nearly an inch in diameter, which perforate it, and are placed equidistant from one another, in the centre of the last, one near the toe, another about half way between the toe and the heel, and the third in the heel. These holes are filled up with wooden plugs, and are made for the purpose of fastening to them the shoe or boot while making, or in the hands of the workman, as it must appear evident, that without this contrivance of the circular holes, it would be totally impossible to secure or nail the leather to the last in order to make the boot or shoe; but when thus adjusted, there is no further difficulty, and the process or work goes on, as herein described, with the new materials instead of the old, and proper instruments calculated for the purpose. In the above description it was deemed unnecessary to enter into a detail of every instrument composing the well-known apparatus for boot and shoe-making, as it has been already shewn that they are here so indispensably requisite, as in the process or operation heretofore pursued. I also apply, as a substitute for thread made of hemp, flax, or other yarns, in the fabrication of braces, traces, or any other articles, to which the same can be usefully applied, and in lieu of stitching or sewing, wires made of iron, brass, or copper, or wires made of any other fit metal. These wires I use lengthways, by stretching them the whole length of the trace or brace; and they are fastened at each end round small metal cylinders, inclosed between plates of leather, connected by means of the first-mentioned substitute, and in manner aforesaid.

In witness whereof, &c.

Specification of the Patent granted to JOHN KENT, *of the Town and County of the Town of Southampton, Architect; for a new and expeditious Method of moving all Kinds of Goods or Materials to high Buildings or from deep Places.* Dated March 12, 1810.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I, the said John Kent, do hereby declare that my said invention is described in manner following; that is to say: My said invention is an improvement on the principle of a lever on a moving fulcrum, whereby power is gained without loss of time, as more fully appears by reference to the drawings annexed, see Plate IV.

The drawings, Figs. 1 and 2, represent a body or weight to be raised, which is supposed to weigh four hundred weight, and to be suspended by a rope or chain passing over the pully B, and fastened at one end to the weight A, and at the other end to the centre of the wheel C, which wheel C is supposed in itself, or by weight attached to it, to be heavier than the weight A, which is to be raised. Now it is evident, that if a power be applied to the top of the wheel C, of two hundred weight, as at D, or a similar weight, to act as a power, as at E, that it will balance the weight A of four hundred pounds, because the power is applied at double the distance that the weight to be raised is from the moving fulcrum which is at the bottom of the wheel C; and if the wheel C be rolled along on an horizontal plane, as the line F represents, the weight A must necessarily be raised as much as the wheel C moves in the surface of the horizontal line or plane which supports it.

The drawings, Figs. 3 and 4, explain my said invention in a compound manner, *viz.* A, the weight to be raised, of four hundred weight; B, the pulley over which the rope or chain passes from the said weight to the centre of the wheel C; D, another wheel joined at its moveable centre to the moveable centre of the wheel C by an iron plate, or otherwise, on each side of the sustaining or friction wheels C and D; E, a roller of sufficient weight to roll on the two sustaining or friction wheels C and D. Now it is alſo evident, that if a power be applied to the centre of the roller E, as at F, of something more than two hundred weight, it will move the said roller round its axis towards the wheel C, by its rolling off the said sustaining wheel D on the said sustaining wheel C, and will thereby move the said sustaining wheel towards the power F, and will lift up the weight A; and if the power at F were joined with iron or any other proper material, from the centre of the roller E to the centre of the other similar sustaining wheels, as from E to K, or in an horizontal direction to the iron or other metal plates that are shewn by the yellow shade, of a semicircular form, or by any other means, from E to G, and also from H to I, as in number four, it would continue to increase the power one half by every pair of such sustaining or friction wheels and roller that may thus be added, *viz.* the first pair of sustaining or friction wheels and roller, marked 3, will balance four hundred weight by a power of two hundred weight; and the second pair of sustaining or friction wheels and roller, marked 4, will balance two hundred weight by a power of one hundred weight; and a third pair of sustaining wheels and rollers, if added, would balance one hundred weight by a power of half a hundred weight; and so on all which is effected by rolling the sustaining wheels and rollers on the horizontal plane, by means of joining the sustaining wheels together from the centre of each roller to the centre of each pair of the sustaining or friction wheels, or to the iron plates, or otherwise, in an horizontal direction which hold the sustaining wheels together; so that, by adding a continuation of sustaining or friction wheels and rollers, any power may be gained without loss of time, provided that the said rollers, which are laid on the said sustaining or friction wheels, are of a sufficient weight in themselves, or by weight attached to them, either by being suspended to the axis of the said rollers, or bearing on their axis, or any other way, as occasion may require; and to which sustaining wheels and rollers fly-wheels may be added if required. The rollers, in some cases, must be of a cylindrical, and at other times of a conical or any other convenient form, and are also made to roll either on an horizontal plane, or

Pl.IV. Vol.XVIII. Secon

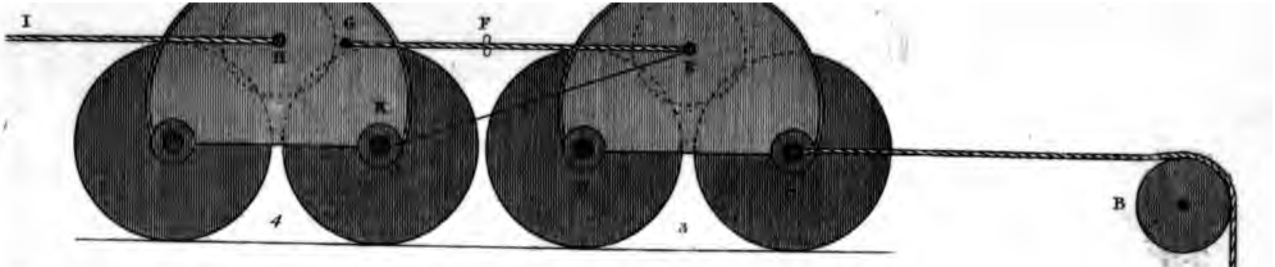
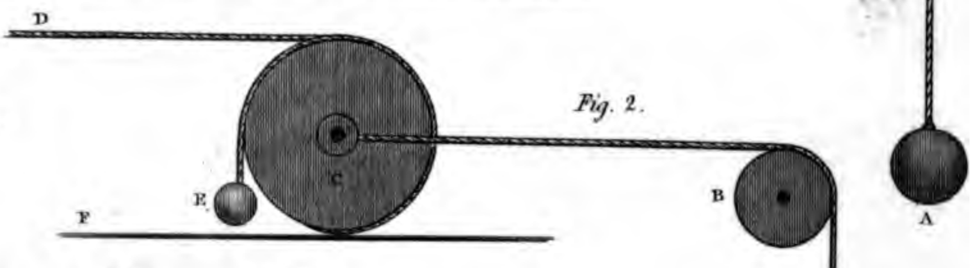
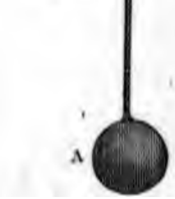




Fig. 2.

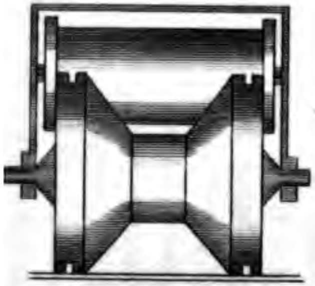


Fig. 3.

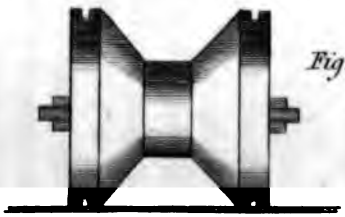


Fig. 1.

r over an inclined plane, as occasion may require. The vention, as before described, I apply to a direct, a otative, a pendulum, a crank, or any other kind of notion that will produce the various effects required.

The drawings annexed are so clearly explained, that by inspection any competent mechanic can apply my said invention to any machinery he may think proper. The various machines that may be required must necessarily differ in form and make, and be composed of different kinds of materials as occasion may require, and may be worked either by animal strength, by water, by wind, by steam, or any other kind of agent, that may be best adapted to the place and purpose required; and, although my said drawings shew my said invention as applied only to raising weights, yet my said invention is also applicable to mills, to pumps, to moving carriages on iron rail-ways, and to various other kinds of machinery.

In witness whereof, &c.

Description of a Carriage on a new Construction, with Six Wheels. By Lieutenant WILLIAM ANDERSON, *of Pershore, in Worcestershire.*

With Engravings.

From the REPORTS of the HOUSE of COMMONS.

THE proposed carriage is formed thus: the middle pair of wheels are of the size of the hind wheels, and the other two pair are of the size of the fore-wheels of common carriages. The centre wheel, being larger, will always have a bearing on the road. The two pair of small wheels are fixed so as to turn in any direction, in the usual manner of fore-wheels; they are connected by the perch, and the fore-wheels turn those behind by means of a small chain, which, being crossed, makes them assume such a direction as that their planes will constantly form tangents to the circle or arcs described by the carriage. The middle wheels are connected with the perch by means of two spurs or cheeks and a double iron strap; the strap is made fast to the axle of the wheels, and the perch passes through it and is united to the spurs, which are also fastened to the axles by a bolt which passes through both. By these means, the middle wheels are retained exactly in their places, and yet will allow the others to rise and fall freely, according to the inequality of the ground, and will also rise and fall themselves. But in order to allow the wheels to pass in succession over the largest obstacles that may probably occur, it will be necessary that the axle of the large wheels should rise at least six inches above the perch. Over the axles of each pair of wheels are placed springs of any description in the usual manner; only, that over the middle axle are placed two pair, the one looking towards the hind, the other towards the fore wheels. The springs on the middle wheels are connected with those before and behind by means of another spring or bar of wood reaching from the one to the other, and on this spring or bar the load or body of the carriage is made to rest as on a lever, and in such a situation as to make each pair of wheels support that portion of the weight which is deemed most advantageous.

The advantages supposed to result from the above mode of construction are, firs', the requiring less power; secondly, the being capable of turning in less

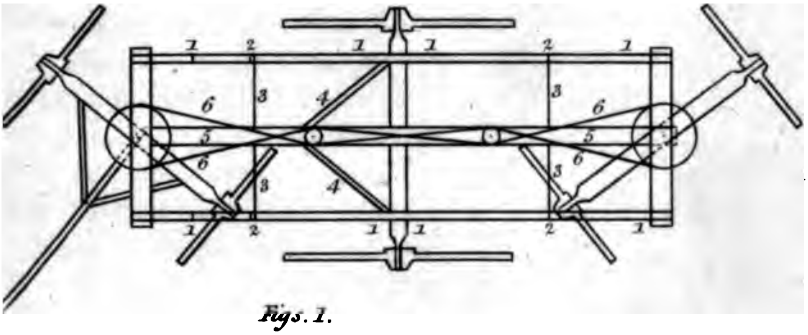
: and with greater facility; and, lastly, being safer,
ss liable to overset.

rst, in respect to power.—All heavy carriages will
: an impression more or less on the road over which
are drawn; and that impression will have the same
t in proportion to its depth below the surface, as a
that makes a similar angle with the horizon. But
greater the number of points by which the weight is
orted, the smaller will be the depth of the impres-
; consequently the greater the number of wheels,
greater will be the facility with which the carriage
be drawn. The most considerable impediment,
ever, to the progress of a carriage, arises from the
l inequalities which exist in the smoothest roads,
over which the wheels are constantly rising and
ng. The effects of ruts and stones or larger ob-
es, make singly a greater impression; but the
ler, from the frequency of their recurrence, are of
: consequence. Whether, however, the impedi-
t be great or small, the advantage of the six wheels
be equally apparent. For in four-wheeled carriages,
half the weight is supported by each pair of wheels;
equently, in the event of moving over an obstacle,
lling into a rut, one half of the whole weight is to
aised through a space equal to the depth of the rut,
he height of the obstacle: whereas in six-wheeled
iages, only one-third the weight is to be raised, and
only through half the space. But another advan-
: in this carriage is, that the load may be made to
: in any proportion on the different wheels; and as
greatest portion of the weight ought undoubtedly to
on the largest wheel, I mean, to let three-sevenths
the whole weight to rest upon the large wheel, so
that

that each pair of small wheels in rising out of a rut, or passing over an obstacle, will have to raise only two-sevenths of the weight instead of one-half as, in four-wheeled carriages, yet the weight on the large will still be but as four to five to that supported by the large wheels in carriages on the usual construction. Upon the whole, therefore, I trust it will be evident, that the proposed carriage will require less power in proportion to the weight to be carried than any now in use.

Secondly, it will turn in less space, and with greater facility.—Carriages with four wheels turn upon the hinder wheels, or upon one end, and consequently require a space, at least equal to their whole length; whereas the proposed carriage turns on the middle pair of wheels or center, and therefore requires only half that space; and the axles of the first and last pair of wheels being kept so as constantly to form radii to the circles or arcs described by the carriage, will be found greatly to facilitate its turning. But farther, as this carriage may be drawn equally well by either end, if it were employed in situations where there was not room sufficient for turning, it would only be necessary to shift the pole instead of backing the horses, as is usual in such cases.

Lastly, in respect to safety.—It has been already observed, and will appear evident on inspection, that the body of the carriage or load rises or falls through a space equal to only one-half of that through which either of the pair of wheels rises or falls; consequently, in the event of any one pair falling into a rut, or being raised by an obstacle, the center of gravity will not be displaced more than one-half of what it would be in carriages on the usual construction; and as in the event of losing



Figs. 1.

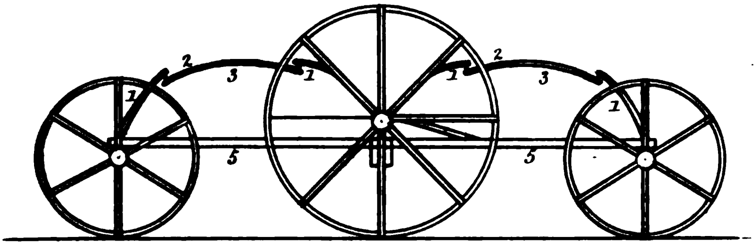


Fig. 3.

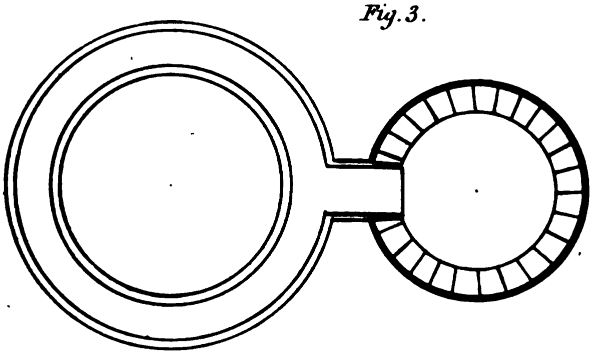
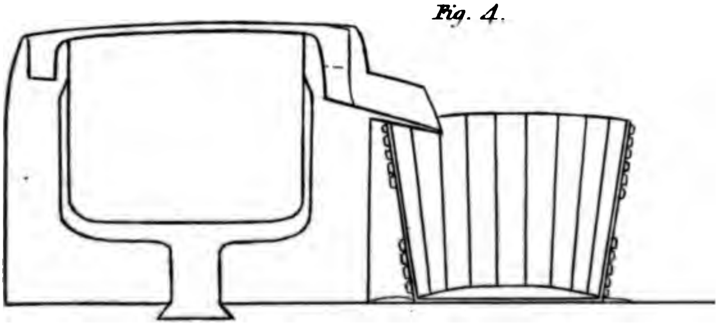


Fig. 4.



losing one wheel of a side, there would still remain two, the carriage would not be overset, consequently it must be safer than any now in use. To the advantages enumerated, might be added that of its being less prejudicial to the roads, as well as many others. At present, however, I shall only further observe, that it may be adapted to any purpose, either as coach or waggon.

EXPLANATION OF THE DRAWING.

(See Plate V. Figs. 1.)

1, springs over the axles.
2, connecting springs.
3, support for the load.
4, spurs or cheeks connecting the great wheels to the perch.
5, perch.
6, chain that turns the hind wheels.

The axles of the fore and hind wheels are in the position they assume when the carriage is turning.

Description of a Boiler for the Use of Tallow-Chandlers and other Manufacturers of inflammable Matters.

By Mr. BREAM, *of Yarmouth.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

THE frequent fires which have lately happened in the different manufactories of tallow, soap, oils, varnishes, and other inflammable matters, in various parts of the kingdom, have induced the Society to publish a description of a model of a boiler presented to them by Mr. Bream, of Yarmouth, in 1786, of which no particulars had been heretofore given in the Society's volumes, and which appears well calculated to prevent the dangerous accidents which often occur from the use of boilers on the common construction.

The very little additional expense attending the make of boilers upon this principle, and the great degree of safety procured by this means, may perhaps claim the attention of government, or of the insurance-offices, to insist upon their use in manufactories of inflammable matters.

The first figure (see Plate V. Fig. 3.) represents a bird's-eye view of the boiler and receiving-vessel; the boiler has a double rim containing a channel, communicating by a spout with a vessel below, placed near the side of the boiler. In case the inflammable matter should boil over the inner rim of the boiler, it is received by the channel betwixt the inner and higher outer rim of it, and conveyed immediately by the spout into the vessel placed underneath, without risk of loss or damage.

The second figure (Fig. 4.) shows a section of the boiler and receiving-vessel; in which it will be observed, that the channel which conveys away the fluid which accidentally boils over is much deeper on the side next the receiving-vessel, in order to accelerate the descent of the boiling fluid into it. The spout should be placed at some distance from the ash-hole and fire-place, for better security.

Description of a Machine for making Slate-pencils.

Invented by Mr. J. BROCKBANK, *of Whirlpipin, near Whitehaven, in Cumberland.*

With a Plate.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

TO place the claims of this invention in their proper light, it may not be improper to state the causes which first led Mr. John Brockbank, the inventor, to turn his thoughts to the construction of this sort of machinery, and to erect a mill for the purpose of making slate-pencils. The specimens which accompany the model now sent will be convincing proofs of its efficacy, and of the superiority of his pencils over all others hitherto manufactured.

In the vicinity of Mr. Brockbank's residence on Black Combe, a lofty mountain in the seigniory of Millom, Cumberland, there is an almost inexhaustible quarry of that species of shale or shiver, peculiarly adapted for this purpose. Having proved this, and being informed that an immense quantity of such pencils were annually imported into this kingdom, under the name of Dutch pencils, he conceived the idea, that the intervals of leisure which his occupations in husbandry allowed him, might be profitably employed, if he could discover some mode of manufacturing pencils that should rival in cheapness, and excel in other respects, those procured from foreign markets. In the outset, this did not seem an easy undertaking; but it has nevertheless been executed with complete success, more particularly when the cheapness of the imported pencils is considered. The encouragement the sale has met with wherever they have been tried, namely in a few of the large towns in Cumberland, Westmoreland, and Lancashire, soon occasioned a greater demand than the inventor was able to supply, whilst the powor of the machine was only impelled by the hand. At that time the long pencils were sold at ten shillings, and the short ones at five shillings per thousand, and he was able to make about twelve hundred of the two sorts *per diem.*

Now that the machinery is worked by water, no greater rapidity of execution is acquired; but it is no longer a work of much bodily exertion, and may be managed by boys; so that if he continue to receive encouragement, he may be induced to extend his machinery, by the addition of more frames. to a larger water wheel, so as to answer the most extensive demand. Humble as this species of manufacture may at first be thought, yet much might be said to show that it has stronger claims to attention than a superficial view of the price and nature of the article might suggest. There is a great and constant demand for such pencils in every village of the kingdom; and that demand has hitherto been supplied by importation from foreign markets.

The machinery at present constructed is worked by a water-wheel of only seven feet diameter, fixed on one end of the axis; a small lever, projecting from the axis, presses down the jaws of a pair of pincers, the lower handle of which pincers is fixed stationary below the axis above-mentioned, and the upper handle is alternately pressed down by the lever, and raised by a crank at its extremity, which is counterbalanced by a weight above it. These pincers first cut the shale or

shivers

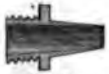


Fig. 2.

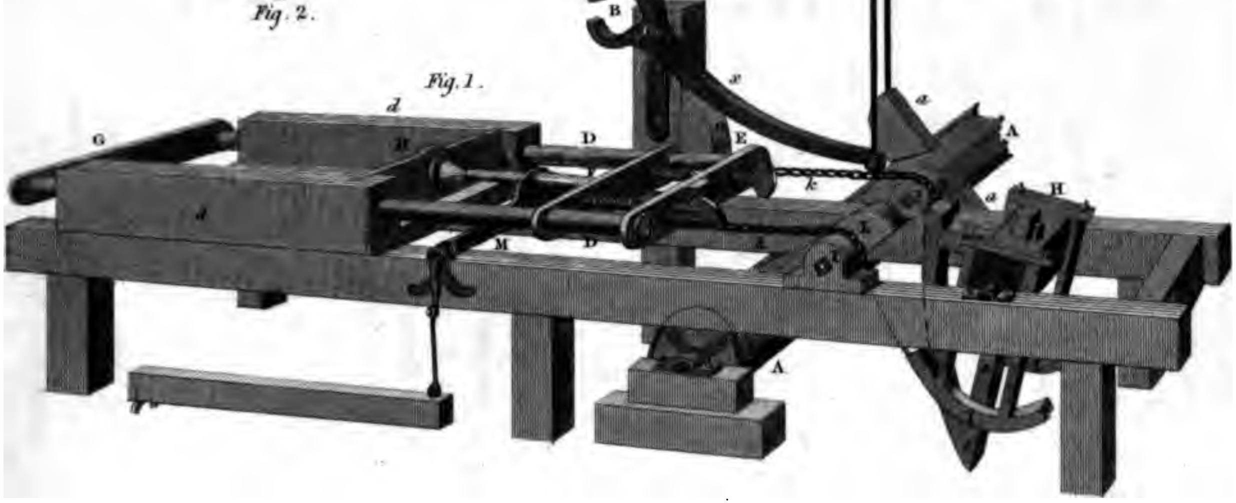


Fig. 1.

shivers into proper lengths or slips, which slips are carried from thence, and one by one entered into the end of a circular sharp-edged tool or tube, something resembling that with which sadlers punch holes in leather; they are forced through this by means of another lever fixed in the axis of the water-wheel, which alternately presses forward the frame sustaining the pencil, and draws back the frame after such pressure by means of a wedge and wheel fixed upon another axle. The pencils are made in a circular form by their pressure through the hollow tube above-mentioned.

EXPLANATION OF THE PLATE.

Mr. Brockbank's machine is shown in perspective in Plate VI, where A A is the axis or shaft of a water-wheel, which gives motion to the machinery; *a a* are two cams or tappets projecting from the axis to work the nippers or pincers B; the lever *x*, which is part of the lower jaw, is lifted up by two rods, which connect it with a heavy lever or counterbalance *b*, and by this means the nippers are opened; the upper jaw is fixed to a post firmly placed in the ground; as the water-wheel revolves, the cam *a* alternately presses down the lever *x*, and closses the nippers, and when the cam *a* has passed by, the weight of the lever *b* opens them again. L is another cam, much larger than the former, (fixed into the same shaft A A), for giving motion to the other machine: D D are two cylindrical rods, connected by the cross pieces E F G, which form a frame; the rods D D slide through holes or sockets in two beams d d, fixed to the frame of the machine; between these two beams an iron plate H is fixed, having a hole in the middle to receive the screw of the cutting tube shown in section in Fig. 2. The frame is pushed away from the axis A by the cam L meeting the cross-bar E of the frame, and it is brought back again by the cam moving a crooked lever *e e e*, which is fixed on an axis H. I I are two arcs of circles, or segments of wheels, fixed on the same axis H; two chains *k k* are fastened to these, and passing over two pulleys *l l*, are fastened to the front piece E of the frame; by these chains the motion of the crooked lever *e e* is communicated to the frame, so as to draw it back ready for the next stroke of the cam L. M is a cross-bar moving upon two centres, having a notch or gap in the middle of it, for one end of the shiver or piece of slate to rest upon; at one end of this bar is an arm, to which is hooked one end of a beam or weight, the other end resting upon the ground; the frame in its action presses down this cross-bar, but it is again replaced in its upright position by the action of the weight upon it.

The materials intended to make the pencils are laid in a convenient place, the person employed generally sitting to the work. In the first operation of the mill, the pincers B very expeditiously pinch or split the materials into slips or lengths, from thence they are received by a person standing to attend the frame, and between the frame and the pincers, one of the points of the slips or lengths, so split or pinched by the pincers, is put into the cutting tube, and the other end rested in the notch of the cross-bar M, the revolution of the water-wheel now forces the frame forward and forms the pencil, by thrusting the slips or lengths before-mentioned through the cutting tube (which should be made of excellent steel), which is screwed into H, the chips or refuse slate falling down under the cutting tube. The

pencil

pencils are then in their second stage, and in order to reduce them to a proper size, the first cutting tube is unscrewed or taken out, and another the size of the intended pencil is fixed in its place; they are forced through this smaller cutting tube by the same operation as before, and the slate pencil is then completely finished, of a beautiful cylindrical form, ready for use.

The two screws *r r*, which either advance or draw back the cross piece F, are to regulate the forcing frame, that all the pencils may be forced through the cutting tube, when the cam L upon the water-wheel axis A A leaves the forcing frame. The water-wheel of the mill is only 7 feet diameter, yet it has sufficient power to work both the pincers and the forcing frame at the same time.

Researches on the oxymuriatic Acid, its Nature and Combinations; and on the Elements of the muriatic Acid. With some Experiments on Sulphur and Phosphorus, made in the Laboratory of the Royal Institution [*].

By H. DAVY, *Esq. Sec. R. S. Prof. Chem. R. I. F. R. S. E.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

THE illustrious discoverer of the oxymuriatic acid considered it as muriatic acid freed from hydrogen [†], and the common muriatic acid as a compound of hydrogene and oxymuriatic acid; and on this he denominated oxymuriatic acid dephlogisticated muriatic acid.

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[*] Communicated to the Royal Society, at the request of the Managers of the Royal Institution.

[†] Mem. Acad. Stockholm for 1774, p. 94.

M. Berthollet [*], a few years after the discovery of Scheele, made a number of important and curious experiments on this body; from which he concluded, that it was composed of muriatic acid gas and oxygen; and this idea for nearly twenty years has been almost universally adopted.

Dr. Henry, in an elaborate series of experiments, made with the view of decomposing muriatic acid gas, ascertained that hydrogen was produced from it, by electricity; and he attributed the phænomenon to water contained in the gas [†].

In the Bakerian lecture for 1808, I have given an account of the action of potassium upon muriatic acid gas, by which more than one-third of its volume of hydrogen is produced; and I have stated, that muriatic acid can in no instance be procured from oxymuriatic acid, or from dry muriates, unless water or its elements be present.

In the second volume of the Memoires d'Arcueil, M. M. Gay-Lussac and Thenard have detailed an extensive series of facts upon muriatic acid, and oxymuriatic acid. Some of their experiments are similar to those I have detailed in the paper just referred to; others are peculiarly their own, and of a very curious kind: their general conclusion is, that muriatic acid gas contains about one quarter of its weight of water; and that oxymuriatic acid is not decomposable by any substances but hydrogen, or such as can form triple combinations with it.

One of the most singular facts that I have observed on this subject, and to which I have before referred, is, that charcoal, even when ignited to whiteness in oxymuriatic or muriatic acid gas, by the Voltaic battery, effects no change in them; if it has been previously freed from hydrogen and moisture by intense ignition in vacuo.

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[*] Journal de Physique, 1785, p. 325.

[†] Phil. Trans. for 1800, p. 191.

This experiment, which I have several times repeated, led me to doubt of the existence of oxygen in that substance, which has been supposed to contain it above all others in a loose and active state; and to make a more rigorous investigation than had been hitherto attempted for its detection.

If oxymuriatic acid gas be introduced into a vessel exhausted of air, containing tin; and the tin be gently heated, and the gas in sufficient quantity, the tin and the gas disappear, and a limpid fluid, precisely the same as Libavius's liquor, is formed;—it occurred to me, that if this substance is a combination of muriatic acid and oxyd of tin, oxyd of tin ought to be separated from it by means of ammonia. I admitted ammoniacal gas over mercury to a small quantity of the liquor of Libavius; it was absorbed with great heat, and no gas was generated; a solid result was obtained, which was of a dull white colour; some of it was heated, to ascertain if it contained oxyd of tin; but the whole volatilised, producing dense pungent fumes.

Another experiment of the same kind, made with great care, and in which the ammonia was used in great excess, proved that the liquor of Libavius cannot be decompounded by ammonia; but that it forms a new combination with this substance.

I have described, on a former occasion, the nature of the operation of phosphorus on oxymuriatic acid; and I have stated that two compounds, one fluid, and the other solid, are formed in the process of combustion, of which the first, on the generally-received theory of the nature of oxymuriatic acid, must be considered as a compound of muriatic acid and phosphorous acid, and the other of muriatic and phosphoric acid. It occurred to me, that if the acids of phosphorus really existed in these combinations, it would not be difficult to obtain them, and thus to gain proofs of the existence of oxygen in oxymuriatic acid.

I made a considerable quantity of the solid compound of oxymuriatic acid and phosphorus by combustion, and saturated it with ammonia, by heating it in a proper receiver filled with ammoniacal gas, on which it acted with great energy, producing much heat; and they formed a white opaque powder. Supposing that this substance was composed of the dry muriates and phosphates of ammonia; as muriate of ammonia is very volatile, and as ammonia is driven off from phosphoric acid, by a heat below redness, I conceived that by igniting the product I obtained, I should procure phosphoric acid; I therefore introduced some of the powder into a tube of green glass, and heated it to redness, out of the contact of air by a spirit lamp; but found, to my great surprise, that it was not at all volatile nor decomposable at this degree of heat, and that it gave off no gaseous matter.

The circumstance that a substance composed principally of oxymuriatic acid and ammonia, should resist decomposition or change at so high a temperature, induced me to pay particular attention to the properties of this new body.

It had no taste nor smell; it did not seem to be soluble, nor did it undergo any perceptible change when digested in boiling water: it did not appear to be acted upon by sulphuric, muriatic, or nitric acids, nor by a strong lixivium of potash. The only processes by which it seemed susceptible of decomposition were by combustion, or the action of ignited hydrat of potash. When brought into the flame of a spirit lamp and made red-hot, it gave feeble indications of inflammation, and tinged the flame of a yellow colour, and left a fixed acid, having the properties of phosphoric acid. When acted on by red-hot hydrat of potash, it emitted a smell of ammonia, burnt where it was in contact with air, and appeared to dissolve in the alkali. The potash which had been so acted upon gave muriatic acid, by the addition of sulphuric acid.

I heated some of the powder to whiteness, in a tube of platina; but it did not appear to alter; and after ignition gave ammonia by the action of fused hydrat of potash.

I caused ammonia, made as dry as possible, to act on the phosphuretted liquor of MM. Gay Lussac and Thenard; and on the sulphuretted muriatic liquor of Dr. Thomson; but no decomposition took place; nor was any muriate of ammonia formed when proper precautions were taken to exclude moisture. The results were new combinations; that from the phosphuretted liquor, was a white solid, from which a part of the phosphorus was separated by heat; but which seemed no further decomposable, even by ignition. That from the sulphuretted liquor was likewise solid, and had various shades of colour, from a bright purple to a golden yellow, according as it was more or less saturated with ammonia; but as these compounds did not present the same uniform and interesting properties, as that from the phosphoric sublimate, I did not examine them minutely: I contented myself by ascertaining that no substance known to contain oxygen could be procured from oxymuriatic acid, in this mode of operation.

It has been said, and taken for granted by many chemists, that when oxymuriatic acid and ammonia act upon each other, water is formed; I have several times made the experiment, and I am convinced that this is not the case. When about 15 or 16 parts of oxymuriatic acid gas are mixed with from 40 to 45 parts of ammoniacal gas, there is a condensation of nearly the whole of the acid and alkaline gasses, and from 5 to 6 parts of nitrogen are produced; and the result is dry muriate of ammonia.

Mr. Cruikshank has shown that oxymuriatic acid and hydrogen, when mixed in proportions nearly equal, produce a matter almost entirely condensible by water; and MM. Gay Lussac and Thenard, have stated that this matter is common muriatic acid gas, and that no water is deposited in the operation. I have made a number of experiments on the action of oxymuriatic acid gas and hydrogen. When these bodies were mixed in equal volumes over water, and introduced into an exhausted vessel and fired by the electric spark, there was always a deposition of a slight vapour, and a condensation of from $\frac{1}{10}$ to $\frac{1}{20}$ of the volume; but the gas remaining was muriatic acid gas. I have attempted to make the experiment in a manner still more refined, by drying the oxymuriatic acid and the hydrogen by introducing them into vessels containing muriate of lime, and by suffering them to combine at common temperatures; but I have never been able to avoid a slight condensation; though in proportion as the gasses were free from oxygen or water, this condensation diminished.

I mixed together sulphuretted hydrogen in a high egree of purity and oxymuriatic acid gas both dried in qual volumes: in this instance, the condensation was ot $\frac{1}{40}$; sulphur, which seemed to contain a little oxy-uriatic acid, was formed on the sides of the vessel; no apour was deposited; and the residual gas contained bout $\frac{1}{8}$ of muriatic acid gas, and the remainder was in-lammable.

MM. Gay Lussac and Thenard have proved by a copious collection of instances, that in the usual cases where oxygen is procured from oxymuriatic acid, water is always present, and muriatic acid gas is formed; now, as it is shewn that oxymuriatic acid gas is converted into muriatic acid gas, by combining with hydrogen, it is scarcely possible to avoid the conclusion, that the oxygen is derived from the decomposition of water, and, consequently, that the idea of the existence of water in muriatic acid gas, is hypothetical, depending upon an assumption which has not yet been proved—the existence of oxygen in oxymuriatic acid gas.

MM. Gay Lussac and Thenard indeed have stated an experiment, which they consider as proving that muriatic acid gas contains one quarter of its weight of combined water. They passed this gas over litharge, and obtained so much water; but it is obvious that in this case they formed the same compound as that produced by the action of oxymuriatic acid on lead; and in this process the muriatic acid must lose its hydrogen, and the lead its oxygen; which of course would form water; these able chemists, indeed, from the conclusion of their memoir, seem aware, that such an explanation may be given, for they say that the oxymuriatic acid *may* be considered as a simple body.

I have repeated those experiments which led me first to suspect the existence of combined water in muriatic acid, with considerable care; I find that, when mercury is made to act upon 1 in volume of muriatic acid gas, by Voltaic electricity, all the acid disappears, calomel is formed, and about .5 of hydrogen evolved.

With potassium, in experiments made over very dry mercury, the quantity of hydrogen is always from 9 to 11, the volume of the muriatic acid gas used being 20.

And in some experiments made very carefully by my brother Mr. John Davy, on the decomposition of muriatic acid gas, by heated tin and zinc, hydrogen equal to about half its volume was disengaged, and metallic muriates, the same as those produced by the combustion of tin and zinc in oxymuriatic gas, resulted.

It is evident from this series of observations, that Scheele's view, (though obscured by terms derived from a vague and unfounded general theory,) of the nature of the oxymuriatic and muriatic acids, may be considered as an expression of facts; whilst the view adopted by the French school of chemistry, and which, till it is minutely examined, appears so beautiful and satisfactory, rests, in the present state of our knowledge, upon hypothetical grounds.

When oxymuriatic acid is acted upon by nearly an equal volume of hydrogen, a combination takes place between them, and muriatic acid gas results. When muriatic acid gas is acted on by mercury, or any other metal, the oxymuriatic acid is attracted from the hydrogen, by the stronger affinity of the metal; and an oxymuriate, exactly similar to that formed by combustion, is produced.

The action of water upon those compounds, which have been usually considered as muriates, or as dry muriates, but which are properly combinations of oxymuriatic acid with inflammable bases, may be easily explained, according to these views of the subject. When water is added in certain quantities to Libavius's liquor, a solid crystallised mass is obtained, from which oxyd of tin and muriate of ammonia can be procured by ammonia. In this case, oxygen may be conceived to be supplied to the tin, and hydrogen to the oxymuriatic acid.

TO BE CONCLUDED IN OUR NEXT.

On the Coal Mines of Sarrebruck, and on the Management of Mines in general.

By M. A. H. De Bonnard, *Mine Surveyor.*

From the Annales de Chimie.

THE intention of this paper is to exhibit a view of the management of the coal mines in the neighbourhood of Sarrebruck. As it is intended to exhibit a specimen of the manner in which mines are managed in Germany, in order to instruct the government on that subject, and to propose the application of the principles upon which that management is founded, it is necessary to make a comparison between the management of mines in France and Germany. This comparison will, in fact, be only a succinct abridgement of a very large report which M. Heron de Villefosse, surveyor-general of the mines in France, and inspector-general of the mines and smelting-houses in the conquered countries, sent in the beginning [illegible] Paris. The [illegible] [redacted] [illegible] the same author [illegible] [illegible] in order [illegible] them.

France [illegible] the richest countries in respect to [illegible] actual chemical mineral [illegible], [illegible] of all the substances extracted [illegible] may be certainly calculated [illegible] francs (4,[illegible]l.), and yet a [illegible] part of the richest mines in its territory is not worked; and the indications [illegible] by many of the [illegible] in respect to the minerals they contain have not been followed up. It is certain, that if the mines that have been abandoned were again worked, and those new mines which are the most promising were opened, these absolute riches would be greatly augmented. Although France always enjoyed a very considerable mining capital, it is nevertheless certain, 1°, that the old government drew but a very small profit from mines; 2°, that the balance of trade, in respect to the produce of mines, was very much against France. In 1787 this disadvantageous balance was no less than 36,569,000 livres (1,523,708*l.*), laying aside gold and silver; and it still remains, in a great measure, notwithstanding the important establishments that France has acquired since that time, and which are comprehended within its present limits.

If the mineral riches of France are compared with those of several states celebrated for their mines, as Austria, Prussia, Saxony, Hanover, Hesse, &c. it will be seen that the absolute mineral riches of France is far more considerable than that of any of those countries; and its relative mineral richness, when considered in proportion to its extent or to its population, is either more considerable, or very nearly equal to that of the states which possess the richest mines. Nevertheless, if the revenue that each of these countries derive from their mines be examined, it will be found that a considerable revenue, arising from the mines, is annually paid into the treasuries of their sovereigns; and that the commercial balance of the substances extracted from mines is rendered advantageous to them in a considerable degree, while this is not the case in France.

Thus, to take Prussia as an example, in which, as in France, the principal mines are of coal or of iron, the absolute mineral richness in 1806 was only nine millions of francs (375,000*l.*), but its relative mineral richness considered, in respect to its extent, was only one-fourth of that of France considered in the same point of view, and in respect to its population only one-third. Nevertheless, at this very period, the commercial balance of the products of mines was 2,152,168 francs (89,673*l.*) in favour of Prussia, and the sovereign drew from them a net annual revenue of about 600,000 francs, or 25,000*l.*

Similar results have been obtained in the other countries just mentioned. Is it not, therefore, to be supposed, that the striking difference between these results

and

and those exhibited by France, arises principally from the manner in which the mines and smelting-houses are conducted in each of those states?

In reality, all the German states owe the flourishing state of their mines and smelting-houses to their excellent management, which has in the different states a very great resemblance to each other, and every where agree in this essential point, that the mines are part of the regalia of the sovereign; whence it follows, that his officers direct all the works, not only those on his own demesnes but also those in private hands.

In addition to this, all the smelting-houses of silver, lead, and copper, throughout the greatest part of Germany, are in the hands of government, as well as the greatest part of the iron furnaces, and many of the mines. The governments of Prussia and Hesse in particular appear to have felt the importance of the principal sources of the mineral riches of their states being managed on account of government, in order that they may be directed according to a regular system; that by a vigilant economy, the duration of their existence should be assured; and that they might be rendered so many practical schools, where the agents and workmen of private establishments might come for instruction. Frederick II. expended very considerable sums of money to create new demesne establishments, and to purchase the renunciation of some important privileges which had been conceded to individuals. His successors have followed his example: several mines and smelting-houses have been purchased by them: they have hired on very long leases some salt-works that were private property, and have contrived to render these establishments the most important mineral works in Prussia.

The organisation of the mines in Prussia only took place in 1769; since that period, the benefit that the state has drawn from the mining population has increased every year; and in the last 20 years, the annual advantage of the balance of trade in respect to minerals has increased to 1,316,697 francs (54,862*l.*) It is remarkable that the same measures were taken nearly at that very time by the Empress Catharine I. in Russia, and by the Emperor Joseph II. in Austria; both of them acquired by these means similar advantages as well for themselves as for their states.

When the many advantages that have resulted to Prussia and the other German states from the organisation of their mines and smelting houses, are considered, as also the rapid increase which it has procured to the industry and the riches of the inhabitants, it is to be wished that the government of France, better informed concerning the importance of mines, and with respect to the defective mode in which they are managed, would endeavour to obtain the advantages of a contrary procedure, by adopting the laws, regulations, and dispositions that have procured them.

The formal recognition of the royal right, the promulgation of a new code of mine laws founded upon that basis, the considering of mines in their true view, that is to say, as a precious source of public riches, the duration of which ought to be carefully guarded, and not merely as a temporary revenue, the power and means afforded to the board of mines to exercise not only a distant superintendance, but the immediate direction of all the works, a general degree of knowledge spread throughout every class of men connected with mines, and lastly the managing and working, by government

itself

itself on its own account, of large and numerous establishments, appear to be the principal means of carrying France to that flourishing state in respect to mining industry, and riches, which nature seems to have destined it.

Two practical schools for miners have indeed been established, one at Pesey, near Moutiers, in the department of Mont-Blanc, and the other at Geislautern, near Sarrebruck, in the department of the Sarre.

The mine at Pesey having been abandoned more than ten years, was in the most complete state of ruin, when the practical school was established there in 1802. The buildings had tumbled down; the wheels and washing troughs no longer existed: the galleries were blocked up and under water. A few years however sufficed, with very small funds, to put it again into a flourishing state, and at present the works yield every year nearly 4000 cwt. of lead, and 2000 marks of silver, the total value of which is about 250,000 francs (10,416*l*.). Its net proceeds in 1806 rose up to nearly 80,000 francs (3,333*l*.) and there is every reason to believe that in the succeeding years they would have risen much higher if nature had not opposed invincible obstacles.

The smelting-house of Geislautern was only put into the hands of the board of mines, at the beginning of 1807. The funds assigned to it for that year, were not sufficient to keep up the works in the same activity as before, and it was only last year that they were able to found a school there. This school is peculiarly intended for instruction relative to the working of coal-mines, and the metallurgic treatment of iron; and it is very advantageously situated for this purpose, in the midst of numerous coal-mines and forges. Three of these forges belonged to the crown, but two had been lately sold, and the school is confined to that of Geislautern. The alienation of these furnaces was in consequence of a principle that had been long acted upon by the government, not to carry on any mines or smelting-houses for its own account. It has just been shewn that the greatest part of the German States act upon the directly opposite principle, and appear to owe the increased state of their mineral riches to it. Shall it be said that a practical knowledge of mining has for many centuries been the peculiar inheritance of the German nation; and that this kind of knowledge has not been carried to the same perfection in France? On this last point, it is not necessary to consult the French books published by the mine-surveyors during the last twelve years, as the falsity of this opinion is allowed by the German writers on the mines of France.

The school at Geislautern being reduced to a single smelting-house, will be obliged to construct very expensive buildings, in order to acquire the dispositions that are necessary for instruction respecting the metallurgic treatment of iron: as to the working of coal-mines, the government already possesses the means of extending the school in that respect to the proper degree, as it has not disposed of the coal-mines of Sarrebruck.

Coal is very abundant in the neighbourhood of Sarrebruck; but it appears that the working of the mines and the use of coal is not very antient. The first extractions were made on the surface by private persons, and without any order. A number of pits were dug by the side of one another, a great deal of ground was turned up, and very little coal was extracted. But the sovereign soon opened regular works, and, towards the middle of the last century, prince William of Nassau seized all the mines of his states, by virtue of his regalia, caused them to be worked for his account upon scientific principles, and thus assured a long existence of this precious material for the country, which was being rapidly exhausted. Since that period, the coal mines at Sarrebruck have always been properly conducted. The mines are worked by galleries, and these are even yet above the level of the valleys; they employ about 500 workmen. The quantity of coal raised annually amounts to about 40,000 *foudres*, or twelve hundred thousand cwt. of coal, whose value is about 500,000 francs (20,833*l.*), but they would yield very easily ten times this quantity.

The principle of mines being part of the regalia of the sovereign, founded as it is on the very nature of things, and acknowledged by all the nations where mines are in a flourishing state; without which, indeed, it is to be apprehended that there cannot exist any regular and durable works, or a good management of mines, is become a question in France, because the last kings of the third race have frequently given up their rights to private persons, and because they have already rendered some places entirely free. Luckily, however, the mines at Sarrebruck have always been considered as the property of the sovereign, most commonly worked upon his account, and always under the direction of his officers; so that the German principle of management in respect to mines may be adopted.

No analogy exists between the division of the soil and the manner in which minerals are deposited in the bowels of the earth, and regular and durable works can

only

ply be established upon the basis of the latter dispositions. The liberty of mining cannot be made to depend upon the division of the surface, without a speedy destruction of those works, by disorderly excavations, as badly conducted as they were badly planned, which ought to be a source of riches to the state for several years. Mines, therefore, cannot be regarded as the property of the possessors of the soil, but they ought to be a species of indivisible property belonging to all the citizens, and of consequence in the hands of the sovereign. The heavy expense that must be incurred at the beginning of a mine in order to assure its continuance, and which is usually much beyond the pecuniary means of the proprietors of the soil, and in general of any private individual, support also this opinion; or, as it may be called, principle, which is acknowledged to be just in Germany, and every country where there are plenty of mines.

Mines were also regalia under the Roman Emperors and the antient Kings of France.

In all the German states the sovereign either exercises immediately his sovereign rights, by causing the mine to be worked upon his own account, or he concedes, for a perpetuity, the right of working a mine to a company, upon certain conditions, which are advantageous to both parties; but in every case, as has been already mentioned, the works are under the immediate inspection of the sovereign's officers, not only in respect to the practical part, but also in respect to the general management and pecuniary matters.

It is, therefore, proposed to adopt one or other of these methods in the coal mines at Sarrebruck.

In the first method, the managers of the practical school at Geislautern would become a provincial council of mines, like those in Prussia, which would direct the works of all the neighbouring coal mines, having under its orders the necessary number of mine surveyors; but it would be most advantageous to charge them with only the practical part and general management. The coals that are extracted beyond what are necessary for the smelting-house at Geislautern, might be delivered to a particular department, composed of one or more persons versed in trade, who should be charged with the sale of the coals, should pay the proceeds into the demesne chest, and should render their accounts to the managers of the demesne, and also to the council of the mine-school. A plan of management should be drawn up every year by the school council, and ordered to be put into execution by the board of mines at Paris. It should contain a detail of all the works to be executed in the course of the year, the necessary expenses, and the quantity of coal that ought to be extracted. The sum of money necessarily required for these expenses should be advanced by the department of the sales into the hands of the council of the school, who should have no other kind of management of the funds, and should give themselves up entirely to the general management of the mines, and direction of the works.

In this mode the sovereign would receive annually the whole nett proceeds of the mines at Sarrebruck, which would amount to about 172,000 francs, (7,166*l.*) from which, however, the expense must be deducted; and after the time was elapsed in which it would be necessary to perform some works to insure the continual and cheap extraction of the coals, it would amount to 212,000 francs (8,838*l.*), and even more as the use of coals become more general.

This method of managing the coal mines at Sarrebruck appears to be the most advantageous for the mines themselves, for the country in which they are situated, for the instruction of the pupils in the mine-school, and of the head workmen of the neighbouring countries, who would come to finish themselves at this really practical school of mining, and, lastly, for the state and for the sovereign.

The second method of management remains to be explained.

If the government does not wish to work the mines upon its own account, it might form the collection of mines which are under its controul (except such as are appropriated to the school of Geislautern) into a number of divisions. According to the French laws at present, these divisions cannot exceed six square leagues, which is much beyond what is allowed in other countries. Each of these divisions must be subdivided into shares; the usual number of which in Germany is 128. Some of these the government should reserve to itself, and these do not contribute to the expenses, but participate in the proceeds. It should give away or sell the other shares, for a long term, at a price proportional to the number of shares it keeps to itself.

According to the law of 1791, the lease of a mine cannot exceed fifty years, which is entirely contrary to the practice in Germany, where the mining companies are always formed in perpetuity, and the shareholders have the power of transferring their shares while the government does not feel the least uneasiness, as the direction of the mine is always in the hands of its own officers; and the refusal of a shareholder to advance his share of the necessary expenses brings on a forfeiture of his share to government. There are evidently many disadvantages in granting a limited lease; for at the end of that term, the works are either in a good state or they are ruined. In the first case, the lease ought to be renewed on every principle of justice, or the new lessees ought to reimburse to the old ones what they have expended on the works, which would commonly amount to more than any new lessees would like to advance upon a work already become old. In the second case, there is no probability of a new grant being made with any advantage to the state, the sovereign, or even the lessees themselves. Again, a company, that has a lease of only fifty years, will endeavour to obtain every advantage during that time, and will not extend its care beyond that period; while a work in perpetuity becomes a patrimony, which the holders are as much interested as government to keep up and husband for posterity. Lastly, leases of a small extent of mining ground given for a perpetuity to a company of shareholders, naturally gives rise to a most efficacious supervisorship on the part of government, which can alone direct, for the general good, an enterprise in which the interest of each individual is but a very small fraction of the general interest; and they offer to the shareholders the chance of only a small loss, or a reasonable gain, without exposing them to those reverses of fortune, of which the working of mines by private individuals afford but too many examples.

The general management and conduct of the works thus belong solely to the officers of government; that is to say, to the members of the mining corps placed for that purpose under the orders of the council of the school at Geislautern, and whose appointments should be taken from the sale of the coals. The expenses, sales, and receipts should, on the other hand, be managed by a company of shareholders, who might nominate a committee to represent them. All the books kept by this committee to be under the controul of the council of the mining school. The shares of the net proceeds to be received either by the government or by the shareholders, as also the advances to be paid in by the latter in case of necessity, should be regulated in a quarterly meeting of the two boards, presided over by the director of the school. All the operations relative to the works should be ordered entirely by the council of the practical school, to which the shareholders should send an agent to watch over their interests, and to propose, on their part, whatever they conceived would be advantageous to the works. All the operations to be ordered in advance for the following year by the grand board of mines at Paris, upon the representations of the council of the practical school. The *budjets* should enter into the detail of all the works to be done, and the expenses to be incurred; and also determine the quantity of coal that should be raised that year.

This disposition of affairs, by which the board of mines determines before hand all affairs for the ensuing year, is a principle that has been long acted upon in all the establishments, whether demesne or private, in Prussia; and has greatly contributed to bring them to the flourishing state in which they all were before the late war. It is also, at the same time, a convincing proof of the works being conducted with talent and probity.

Why should a company fear the publicity given to their transactions if they did not make some unlawful gains? In Germany, an abstract of the accounts of every mine is published quarterly, and all the managers of mines and smelting-houses endeavour to give the utmost publicity to all their operations.

On improving the Manufacture of Gunpowder.

By Mr. L. J. PROUST.

(Concluded from Page 64.)

CHARCOAL made of blood or tanned leather burns, as has been already mentioned, very badly with saltpetre. The first sort throws out sparks that evidently arise from iron in its metallic state, as is also demonstrated by the use of acids and by the bituminous hydrogen that is emitted. On the third operation these sorts of charcoal still yielded some traces of prussic acid, but none on the fourth. Did they become more combustible than before? No: they were even still more lazy in decomposing their saltpetre.

What consequences are to be drawn from these facts? None; in order that nothing may be put to the hazard: for if the separation of azote appears in some cases to augment their combustibility a little, in others it causes a diminution. So that it is not the presence of that element that causes those differences which are perceivable in the scale of combustibility of different kinds of charcoal.

It is also in vain to attribute the difference to the various degrees of heat which are used for their preparation. For how comes it, for example, that charcoal prepared from maize and its stalk, in the very same retort, and of course by the same temperature, should be found so different as they appear to be by the table? The same would, doubtless, happen with wheat, rice, their straw, and probably also with all the woods, if they were mixed and carbonised in the very same crucible; so that, if the density of the carbonaceous molecules has any influence on their combustion, it certainly is not owing to the different degrees of heat by which they are prepared.

Let us then interrogate, in its turn, hydrogen. Let us interrogate that principle, whose abundance in charcoal authorises us to consider it as the foreign substance that has the greatest share in the acceleration of their combustibility.

It cannot, in fact, be denied, but that the absence of hydrogen in diamond, plumbago, and anthracite, explains very well the condensed aggregation which appears to cause the resistance they offer to the efforts of oxygen, and, of course, the difference of combustibility that is discoverable between these products and the common vegetables in charcoal. And as, on the contrary, this very principle, either simply condensed or, in other words, combined, is found in charcoal, it must be allowed that it has a great influence on the combustion. This is the opinion of Berthollet.

But some particularities present themselves here, relative to the object in view, which ought to be examined, especially as the parallel cases which occasioned their discovery have not hitherto been noticed, and, therefore, no person has been led to observe them,

Thus, for example, if a live coal is left in the open air, the hydrogen may accelerate its combustion, because, as it is combustible itself, it takes fire, and envelopes the charcoal in some measure with its own fire;

but the case is different when the same charcoal is shut up in a tube with saltpetre, or, in other words, when the charcoal has no communication with the ambient air. In this second case, the hydrogen that is indeed present, but in a very different situation, cannot act the same part with the other combustible as when it is in the open air. It produces of itself new results, which it is essentially necessary to understand, on account of the facility with which they explain the effects that happen when gunpowder is fired in a piece of artillery. If these new results should of themselves only confirm or add to that which the modern theory has justly shewn to take place, the consequences to be drawn from them cannot but be adopted.

When then common charcoal is burned in the open air, or in oxygen gas, all the combustible ingredients that make up its mass appropriate to themselves, each according to its means, the quantity of oxygen that is necessary for their saturation; all are burned, and the tendency of any one ingredient in this respect can never hinder that of the others, as long as there is oxygen sufficient for all. But when charcoal is burned in a tube with five or six times its weight of saltpetre, which are the two proportions made use of in the manufacture of gunpowder, one of the two combustible ingredients, or the carbone only, is burned, while the hydrogen finds an obstacle in the attractions which occur in this new situation, that it cannot overcome; as follows:

In the proportion of six parts of saltpetre to one of charcoal there is a notable excess of the latter relative to the quantity of oxygen that the first can yield, as has been shewn on other occasions. When, therefore, this mixture is detonated, the excess here mentioned is

not

burned : it is only ignited along with the gases that
ow it out of the tube, and then all the part it has to
y is merely to augment the flame with a sheaf of
rks, as is seen every day in fire-works. It burns at
there is no doubt, but it is only by means of the at-
sphere and on account of its not having found in the
the element that is necessary for its combustion.

n reality, if charcoal, which never fails at a red heat
decompose the saltpetre and water that comes in con-
t with it, is not able to extract from that salt a suffi-
nt quantity of oxygen, to be entirely consumed, how
the hydrogen combine with any part of the oxygen.
what inversion of attractions can this hydrogen be-
ne oxygenised. It may, therefore be concluded at
gth, that whenever there is an excess of charcoal in
nixture it is impossible for hydrogen to take away the
st quantity of oxygen from the carbone.

This is the difference between the combustion of
rcoal in the open air and its combustion in a tube
h the above-mentioned quantity of saltpetre. In the
t case, both hydrogen and carbone are burned by
ans of the atmospheric air, but in the second, the
tpetre furnishes oxygen to the carbone exclusively,
d not to the other principle. Thus it appears, that
enever the mixtures have been appropriated for fur-
shing hydrogen, this gas escapes untouched from the
olent explosions, and has no other effect but to add
echanically to the volume of the gases, and to arrive
f course at the mouth of the gun, where it burns along
ith the excess of the charcoal and the other combusti-
les that accompany it; a circumstance which certainly
vould not happen if they were capable of attracting
art of the oxygen of the saltpetre. Whence it may also
be

be concluded, that during the detonation of gunpowder, water is very capable of being decomposed, and of increasing the volume of the other gases by that of its component gases, but not to be reproduced, as Lavoisier had judged to be probably the case. To give in this place the proof of what is now advanced would be an anticipation of the third part of this essay: let us, therefore, return to the influence that hydrogen has in the combustion of charcoal in tubes.

Can hydrogen then, as a combustible body, accelerate the combustion of charcoal in tubes? It is not probable, as has just been shewn; nevertheless, it may very likely contribute to this effect, and even ought to do so, by a mere mechanical influence, that can scarcely be refused it. How is it possible that hydrogen should not render the carbonaceous molecule more apt for motion when it is as it were enchased in the bosom of the carbone, that it should not render the carbone lighter, more dilatable by heat, and by that means more ready to combine with oxygen? Whatever may be the difference between hydrogen and carbone on the scale of dilatability, this use cannot be considered as foreign to it, as the charcoal always possesses a power that combines it very forcibly with that combustible body, and this union is preserved even in the most elevated temperatures. This truth has been so fully shewn by the experiments of Kirwan and Berthollet as to be no longer questionable. So that the hydrogen, especially that portion of it which is the most strongly attached to the carbone, and the quantity of which is, according to all appearance, much more considerable than that of the other portion, which yields so easily to the slightest heat, may very probably, in this point of view, contribute to make certain kinds of charcoal more combustible than others, in the above-mentioned situation. How many experiments, however, would not all this require? Those which have been begun to be made are here mentioned.

To discover, if possible, some proportion between those kinds of charcoal whose combustibility is very different; such, for example, as those of walnut-tree wood and of hemp, which, according to the table, are as 29 and 10; a trial was made to measure the quantity of uncombined hydrogen that could be extracted from them by a red heat in the same furnace. In consequence, 100 grains of each were submitted to distillation in two small well-luted glass retorts, with the necessary precautions to receive the air of the retorts separate.

The produce of the walnut-tree wood charcoal washed with lime has mounted to 29 (cubic) inches, and that of the hemp to 36. The first burned much slower than the second, and with a bluer flame; it therefore seemed to contain more gaseous oxyd of carbone than the other; but these two products throw very little light upon the point under discussion. There is not, on the one hand, a sufficient difference between them to form any positive conclusion; and, on the other hand, the experiments do not shew the whole quantity of hydrogen, especially that portion which nothing but a strong and long-continued heat can separate from charcoal; so that, in one word, some other method must be adopted.

The gas emitted by charcoal made of the ever-green oak, left, on being analysed in Volta's eudiometer, a quantity of azote, which at the time caused some surprise. The atmosphere, however, had no share in it, for Berthollet has also discovered it in other kinds of charcoal. Does this azote, which is only separable by means of heat, form a part of that which contributes to the formation of the prussic acid. A great number of different kinds of charcoal, pulverised and burned in a cast-iron crucible, exhale ammonia unto the end of their combustion; which plainly shews that the hydrogen they contain does not in these cases burn alone by itself.

Let us not, also, lose sight of the circumstance, that the mere application of heat to charcoal, when it is considered as a means of attaining a valuation of the combustibility, will never be able to dispel the clouds which envelope the question. For if, on the one hand, the principle that appears to impress a greater degree of combustibility upon the carbonaceous molecules than it naturally enjoys is separated, yet, on the other hand, there happens an accumulation of several causes of alterations, such as hardening, fritting, &c. which all tend to efface, in a greater or less degree, those traces of uniformity that pure charcoal, like all other combustibles, must necessarily enjoy. So that we must resolve to wait until the progress of the science shall discover some other means of discovering the part that hydrogen acts in the combustion of charcoal, in those cases in which it is very evident that it cannot appropriate to itself any of the oxygen of the saltpetre.

The difference of specific gravity being also one of the causes to which some influence in the combustibility of the different kinds of charcoal may reasonably be attributed, this would be the proper place to speak of it; but, as no experiments have been made respecting it, a few considerations only on this point can be here mentioned.

It is the general opinion, in the manufactories of gunpowder, that light, sonorous, and brittle charcoal ought to be preferred to that which does not possess these qualities. The kinds of charcoal that possess these qualities are sufficiently numerous; and it is always easy to procure them. Nevertheless, they have never dared in France to free themselves, in this respect, from the difficulty to which a regulation made in 1685 has subjected them. It may perhaps be instructive to quote the text. This regulation imposes the exclusive use of charcoal made of the bourdeine, "because," it says, "the defects of gunpowder arose," formerly, "in some degree, from the manufacturers using charcoal made of willow and other white woods of a bad quality," &c. Perhaps the suggestions of some alert contractor may have had the good fortune to have established this regulation: why not? for, if the willow, and the other white woods, ought to be depreciated in the manner we have just seen, it is not very evident upon what grounds charcoal, made of bourdeine, has been able to exalt itself above its companions, or why the preference should be given to it.

Some thinking men of the last century endeavoured, however, to get rid of this prejudice. They examined the bourdeine, and the other white woods, in respect to the improvement of gunpowder; but, whatever might be the knowledge that they acquired by their labour, the Board of gunpowder and saltpetre, standing upon the ground that it would not be imposed upon by prejudices, has not yet thought it the proper time to attack that respecting the bourdeine, because, independent of a number of considerations that need not be mentioned, there is required, in a matter of this importance, a greater number of more fundamental trials, and performed in a more solemn manner than has yet been made.

All that has been done by Beaume, Morozzi of Turin, and others, may be ranked in the same class, as, on the one hand, their researches concerning the qualities of charcoal would not be looked upon by modern chemists; and on the other, because there are some great objections, as will be shewn hereafter, to the most advantageous results that they obtained, on account of the mode of trying the powder, whether by the mortar, or the regulation powder-tryers.

The English distilled coal (coak), has also been vaunted as an excellent ingredient for making the best gunpowder; but no notice is here taken of it, because the trials that have been made with it are not published, and of course any objections that might be made to the trials themselves cannot be examined.

Therefore, in order to begin the researches which this important part in the history of gunpowder requires, a table ought to be made of a series of different kinds of charcoal in the order of their specific gravity, and on the side, their combustion with saltpetre, in order to discover what proportion and similarities can be observed between these two qualities. This examination composed a part of the plan that was marked out, but it was laid aside until another series was undertaken, which will be mentioned immediately, because these two series of experiments go hand in hand together as to the collection of the materials and the making of the trials: but .... another void .... easy enough to be filled up. Several pieces of all the kinds of charcoal that appeared to be necessary to be examined have been begun to be collected; and, until this work can be undertaken, only two data can here be given from the trials with gunpowder made by the late Cossigni, a laborious but unfortunately an unsuccessful inquirer on this subject, as he was deficient in the most elementary notions of chemistry.

Among the several kinds of charcoal that Cossigni examined in regard to the point in view, he found the specific weight of that of spindlewood-tree and the bourdeine to be as 17 and 26, which is a striking difference; but yet the different duration of their combustibility does not agree with these two terms, for they are almost alike in the above table, as they are there quoted 21 and 20; that is to say, these kinds of charcoal, although very different in weight, do not perceptibly differ in their manner of burning with saltpetre; but as these two facts, taken separately, cannot afford the necessary light on the subject, it is necessary to pass on to another examination that has been already mentioned.

Whatever may be the substances that alter the purity of charcoal, or, in other words, whatever modifications of density may occasion the difference of time that they take up in burning, it is easy to perceive that these differences may be considered as to their effect in respect to the economy of fuel. If the detonation of the different kinds of charcoal with saltpetre affords a method of ascertaining their duration, why should we not apply this scale of valuation to all the kinds of fuel used in Europe? It was indeed intended to pursue this examination with the specimens that had been begun to be collected.

Several artists, such as those employed in making steel, refining, small and large foundery, and the heating of stoves in all kinds of manufactories, have learned to distinguish the kind of charcoal that is the most proper for their purpose. It has been already shewn, that they have learned, in those parts of Spain which do not possess any fossil coal, to distinguish the charcoal that lasts the longest time in the forge; but, notwithstanding this knowledge, which is indeed as vague as the repeated trials by which it was acquired, our artists are still ignorant of the proper method of finding the true valuation of their duration, and of course of their real intrinsic value, paying no attention to those causes that vary their price in trade. It would appear, from the above, that the trial of charcoal with saltpetre might afford this valuation with sufficient precision. The combustion of charcoal in the open air is of itself only a prolonged detonation, and the chemical action that it exercises upon the oxygen condensed in water, in hyperoxygenised muriates, in saltpetre, in oxides, &c. certainly do not differ from those that it exercises on the atmospheric oxygen. Causes, effects, results, are they not all alike in the two methods of burning? But, on the other hand, detonation in tubes affords a facility of circumscribing the progress within satisfactory limits, as it can be subjected to a comparison of which no other kind of combustion is susceptible, as a great number of objections may, as is easy to be conceived, be made against the comparison of different kinds of charcoal by burning them under vessels filled with water, in order to discover what quantity of water they can evaporate in a given time.

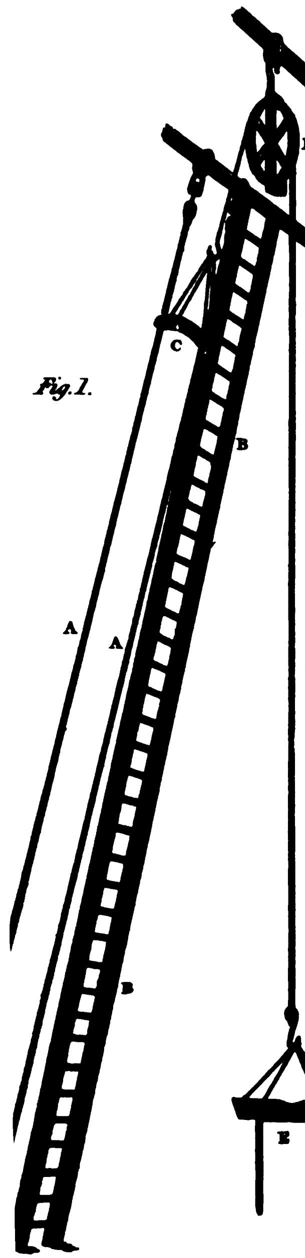


Fig. 1.

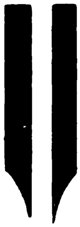


Fig. 2.

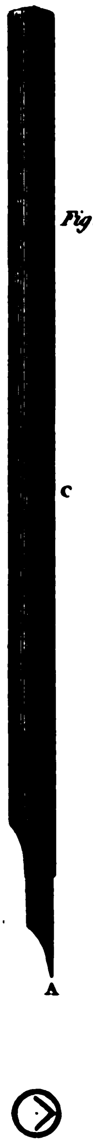


Fig. 3.

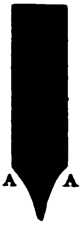


Fig. 4.

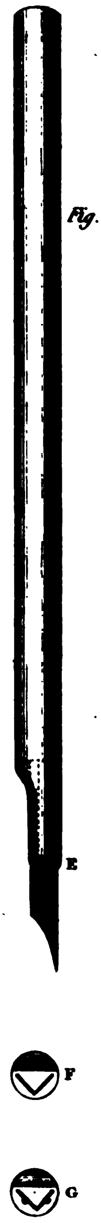


Fig. 5.

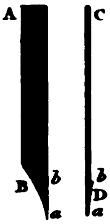


Fig. 6.

Intelligence relating to Arts, Manufactures, &c.

(Authentic Communications for this Department of our Work will be thankfully received.)

Trial of a Patent-right.

Court of King's Bench—Thursday, December 1810.

BAINBRIDGE *v.* WIGLEY.

THE Plaintiff and Defendant in this case were both musical instrument-makers. The action was brought for an infringement of the Plaintiff's patent-right, of exclusive making his improved *flageolet.* The Plaintiff's specification stated, that he had improved the flageolet, by perfecting notes which were before imperfect on the old instrument, by giving it a power of producing *notes* not before to be produced on the old instrument; and also for rendering the fingering of it less complicated, inasmuch, as on his improved instrument *cross* fingering was avoided, and the notes were produced by raising the fingers in succession, and in their natural order. Another improvement, resulting from this mode of fingering, was, that the music might be pricked as easily by cyphers as by the musical characters. The specification then set out the mode by which this was effected, which was by additional keys, by varying the position, and altering the dimensions of some of the finger-holes. Some objections were taken to the specification; but Lord Ellenborough held that the specification was only the *modus operandi;* and in order to ascertain whether that was good or not, would be to call competent workmen, and to ask them whether they could make the instrument by the mode therein specified. Two witnesses, Mr. Sharpe, the flageolet player at the Opera House, and the person who played the same instrument at the Lyceum, were called, to describe the improvements of the Plaintiff's [illegible] instrument. They both described it as a great improvement. In the old instrument C natural on the [illegible] octave was so imperfect and discordant a note that [illegible] transposed music into another key to avoid [illegible] the patent flageolet also they could go as high as [illegible], which was a note beyond the compass of the old instrument. It did not, however, appear that it produced any other new note.

Lord Ellenborough held that this would be fatal to the patent, the ground on which it was granted having failed; the consideration on which his Majesty was induced to grant his patent not being truly stated; it was granted on the faith that the Patentee had truly stated the grounds on which he claimed that exclusive privilege. It was here stated that the Plaintiff had, by his improvement, given *new notes* to the instrument, whereas, in fact, he had produced but *one* new note.

His Lordship having intimated this opinion, the parties, after a short consultation of the counsel, came to a compromise. It was agreed to withdraw a juror, by which both sides pay their own costs, and the Plaintiff undertook to bring no new action.

List of Patents for Inventions, &c.

(Continued from Page 64.)

PETER BROWN, of Henrietta-street, Covent Garden, in the county of Middlesex, Gentleman; for an improved construction of buoys for ships or vessels, and for mooring chains, or similar purposes. Dated September 26, 1810. Specification to be enrolled within six months.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CV. SECOND SERIES. Feb. 1811.

Specification of the Patent granted to SIMEON THOMPSON, *of Maddox-street, Hanover-square, in the County of Middlesex, Gentleman; for a Machine or Machinery for raising, lowering, drawing, driving, forcing, impressing, or moving Bodies, Substances, Materials, Fluids, Articles, or Commodities.*

Dated March 20, 1809.

With an Engraving.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Simeon Thompson do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say:

In the drawing hereunto annexed, the lines A A, Fig. 1, (Plate VII.) denote certain parallel ropes duly stretched and secured, or certain leading pieces or sliders, placed for the purpose of steadily conducting a seat or carriage C, in which a man can or may sit and descend from the upper to the lower points of the said ropes, leading pieces, or sliders. And the said ropes, leading pieces, or sliders, may be either perpendicular or inclined in the positions thereof; but I find it most convenient to give an inclined position to the same, in an angle of about twenty degrees from the perpendicular. And I secure the said carriage by connecting the same unto the said ropes, leading pieces, or sliders, by rings or loops, or bearing parts, of such form and figure that the said carriage shall be confined in the descent and ascent thereof. And farther, I connect the said carriage to and with the weight or counterpoise, or place of re-action, represented by the letter E, to be either raised, lowered, or suspended, or at which or where the intended work or operation is to be done and performed, by means of a rope or chain, or other flexible material, passing over the wheel, pulley, or sheeve D; and B B represents a ladder, or steps, or shrouds, for the workman or workmen to ascend.

And the manner of using or working the said machine or machinery is described as follows: The workman ascends by B B, and places himself in the carriage C, in which his weight (by preference) forms nearly an equilibrium with the weight E (which may be imagined to be a basket of coals). In this situation, by a moderate exertion of his arms, either by taking hold of the leading ropes, or of a rope passing downwards for that purpose, he causes the carriage to descend briskly, which at the same time brings up E. He then quits the carriage, and at that time E, (which we suppose to have been emptied by another assistant, by reversing it or otherwise,) being somewhat heavier than C, descends again, and raises C to its first situation; and by the time E is again filled, the workman is ready at the top of the ladder, where he enters the carriage, and raises a second load; and in this manner the work may be continued at pleasure. And the said work may be performed by two or more workmen ascending and descending in succession by means of the same ladder, or, if more convenient by more ladders than one. And in case it should be desired that the body E should be lifted through a greater space than is to be ascended by the workman upon B B, the same may be effected by fixing D higher, and causing two carriages to descend in succession along the ropes or guides A A, or otherwise, but not by preference. The rope D E may be wound on a barrel, and the rope D C on another, or smaller barrel, both on the same axis.

And farther I do declare, that the said machine or machinery is applicable to drawing, driving, forcing, impressing, or moving bodies, substances, materials, fluids, articles, or commodities; and that in such applications and uses of the same, no other variations in the construction, connection, and working thereof will be needful, but such as may and can with facility be made by any person of competent skill in the ordinary course of mechanical works and operations.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

The vulgar objection to this plan is ascending the ladder. It is its chief recommendation, for it is the easiest method of raising a weight; and the truth of this assertion will be ascertained from the following statement.

If it be required to raise a sack of corn, a basket of coals, or any other equal weight, to the height of forty feet (more or less), no method can be so easy to the person who is to raise the weight as to ascend stairs or a ladder unincumbered, and to raise the sack, &c. by his own weight. By no other exertion of his own, nor by the assistance of any mechanical powers, can he perform the same operation in the same time. It must, consequently, be the easiest method of raising a weight, or it could not be done in the shortest time. If it is easier in one operation, it must be equally so in any number of operations. If it is easier for one man, it must be equally so where any number of men can be employed to work together in raising of heavy weights, and where this principle can be introduced. If it is easier, it must be cheaper. The labour consists in ascending the ladder; and in this exertion the man's muscular powers are all in action at the same time, not partially used, as in most other modes of raising weights. His strength may be combined with his gravity in his descent, and is opposed by the least possible friction. He cannot work with greater advantage.

Desaguliers states the maximum of a man's power to be as under:

1 Man....500 Pounds....12 Feet.....1 Minute.

The weight raised was water in a bucket. The man, who was very powerful, ascended stairs with a weight about his person, which, together with his own, was equal to the water, and placed himself on or in an empty bucket, which was suspended by a rope passing over a pulley, and fastened to the bucket containing the water below, and raised it in the time. The man was so exhausted that he could not repeat the operation.

The following experiment has often been exhibited by the present invention :

1 Man....1500 Pounds....12 Feet....1 Minute.

And this difference arises from the man's strength being combined with his gravity, and the facilities which the two parallel ropes afford him, to gain velocity by a slight exertion of his arms, to arrest his descent, and quickly to re-ascend the ladder.

If a man weighs 14 stone, or 196 lbs. and ascends the ladder eight times in the minute, (which almost any active man may do,) it is clear that he can raise eight times his own weight, 1568 lbs.

The steps of the ladder being one foot apart of each other, (that stride being found most agreeable to the labourers,) if a man ascends as slow as possible, that is at the rate of one foot each second, he will ascend five times in the minute to the height of twelve feet; and if he weighs twelve stone, or 168 lbs. (the average weight of a labouring man,) he will raise his weight five times, or 840 lbs. in the time. He will probably consume ten seconds in ascending, and one or two seconds in descending and raising the weight. He cannot work slower. Applying this rate of work, the result of one man's power, for one hour, in raising of the undermentioned articles will be,

Coals	10 chaldrons	20 feet.
Malt, barley, oats, &c.	90 quarters	20
Bricks	6,000	20
Water	3,000 gallons	20

Halving the weight when doubling the distance.

The following weights have already been raised:

		Men.	Feet.	Hours.	Mi.
Coals *	240 chaldrons	2	8½ to 21	17	7
Bricks †	22,000	2	40	7½	0
Ditto	6,000	2	40	1	0
Ditto	1,500	2	40	0	12

There are four men employed to raise a basket of coals on the river Thames, and six on many parts of the coast. It has hitherto been found impossible to establish or even to try this plan on board of any collier in the river Thames. It has been used at Brighton, where one of Messrs. Lashmar's ships was discharged by it a few weeks since, with four men short of the usual complement, and in rather less than the usual time. The four men working in the hold could not fill the basket faster, or the vessel would have been discharged in half of the usual time. The two men who worked the machine waited nearly half of the time for a supply, and could have raised twenty chaldrons *per* hour instead of twelve, the quantity with which they were supplied. It is intended to increase the number of men in the hold to six on the next trial.

This plan has been established at the East India Docks for nearly twelve months, where all the Indiamen are discharged by it. The first ship, on-board of which it was tried, was the Fort-William, laden with bales of cotton, and weighing about 2¼ each. The bales were raised by two men only. The Porcher was delivered at the same time by the old plan, and contained a similar cargo; each bale was raised by six men.

---

* The coals in baskets similar to those used on the river Thames.

† The bricks (two hods) about thirty-four at a time.

From the Fort-William 5532 bales were delivered in 17 days.
From the Porcher .... 5022 .... in 20 days.

Leaving an advantage of four men, three days, and a surplus of 510 bales in favour of the Fort-William. The men who raised the bales on-board of the Fort-William stood still nearly half of the time, as the weighers could not pass the bales quicker through the scales. The men who raised the bales from the Porcher were fully employed, and exerted themselves to the utmost, with the hope of preventing the establishment of the new plan.

The principle of this invention may be applied, and will be found equally useful, in pile-driving.

This plan has been offered to the City of London in a memorial, which was presented early in the late year to the Lord Mayor and Court of Aldermen, of which the following is a copy:

Sheweth, That your Memorialist has invented a method by which the labour and expense of two men may be saved in raising the basket on-board of colliers, which saving will amount to 15,000*l.* * *per annum*, according to the present allowance of 3*s.* *per* score chaldrons each man:

That the machine is simple, fixed with great facility, and perfectly safe in its operation:

That two men have already raised 240 chaldron of coals, by the use of this machine, in seventeen hours and seven minutes, without changing, and have made an affidavit of the same before the Right Hon. the late Lord Mayor, of which the following is a copy:

---

* The wages of the men have been increased since this period; and as the diminution of men has been confined to two, but would probably extend to three in many of the small ships, the saving would now amount to 20,000*l.* *per annum*.

London } Hugh Rossiter and John Stokes, scaffold-
to wit. } men, and both employed until within the last three months at the new Theatre Covent Garden, severally make oath and say, that on Saturday, September the 23d last past, they raised, to the height of forty feet, 22,000 bricks in seven hours and a half by one of the machines fixed next to the corner of Duke-street, Lincoln's Inn-fields; and that they have since raised 240 chaldrons of coals in two days, in the following manner:

	Chaldrons.		Hours.	Min.
First day	150	in	9	0
Second day	90	in	8	7
	240		17	7

Beginning at eight feet and a half and ending at twenty-one feet, the depth of a ship's hold.

Witness, John Payne.
Hugh Rossiter.
John + Stokes, his mark.

Sworn at the Mansion House, London, October 7, 1809, before me C. FLOWER, Mayor.

Your Memorialist humbly conceives that the before-recited affidavit is a complete answer to any objection or opinion which may be urged against this method; the quantity of coals therein stated being greater than was ever raised by any four men to the same height and in the same time.

Your Memorialist proposes to give to the City of London the use of his patent, on the condition that a part of the saving arising from it may be devoted to a fund for bettering the present, and gradually improving the future condition of the men, and eventually of establishing some asylum or provision for them and their families when age or accident may have disabled them from working.

'Your Memorialist is informed, that the men have not at present any common benefit society.

Your Memorialist begs leave to suggest that this fund will be supplied by its own members, who will feel an interest in their saving, and provide by the energies of manhood, for the infirmities of old age, without applying to the parishes as is the case at present.

Your Memorialist further observes, that any man may work by this plan, no drilling being required, and as it is merely an improvement of the old principle, it should not be regarded like the substitution of any other power, for that of man; such as a steam-engine, horse power, &c. &c.

It is not the wish of your Memorialist to obtrude his plan on the men, nor to take any part in the dispute respecting an increase of pay, either now or at any other time; but humbly to solicit this Honourable Court, after weighing the proposals herein contained, to recommend its adoption to the men, and to explain the advantages they will derive from it.

The work being considered a preferable kind of work, your Memorialist conceives that this Honourable Court will at all times have a controul over the men; and that it may hereafter be considered a favour to be admitted into a gang, and a member of such a society.

Your Memorialist considers that to promote the comfort, to improve the condition, and to regulate the conduct of a most useful body of men in this metropolis, by means so salutary and certain, and eventually to extinguish the apprehension, or even the possibility, of a recurrence of those events which have often been attended with evil consequences, and are at all times to be contemplated with alarm, cannot be a matter of indifference either to the government of the country, or to an enlightened magistracy.

Your Memorialist does not wish or require, either for the men or himself, any advantage or remuneration, but what will accrue from his plan, the distribution of which he will leave to this Honourable Court.

Maddox-street, 1810. SIMEON THOMPSON.

Specification of the Patent granted to BRYAN DONKIN, *of Fort-place, Bermondsey, in the County of Surrey, Gentleman; for a Pen on a new Construction.*

Dated March 14, 1808.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I, the said Bryan Donkin, do hereby declare that my said invention is described in manner following; that is to say: Instead of making my pen with its sides or those parts which are situated on each side of the slit, cylindrical or circular, with regard to any section supposed to be nearly at right angles to the direction of the length thereof, as the said sides or parts are formed in all pens hitherto made, whether out of quills or any other materials: I do make the said sides flat or nearly so, in order that the same may easily and pleasantly spring back from pressure when used, and readily return

turn to their first situation, whatever may be the size, figure, or description of the characters of the writing therewith to be performed. And I do make the said sides or parts separate and distinct from each other, as represented in (Plate VII.) Fig. 2. and do afterwards fix the same together into a tube or pipe or other fit receptacle; and the said sides being applied to each other in an angular position, as represented in the section at F, do constitute a pen as shewn in Fig. 3, where A represents the points, and C the tube into which the said sides are inserted. Or otherwise I do make the said sides or parts of my said pen of one entire piece, as in Fig. 4, (still preserving the flatness instead of the usual cylindrical form,) where A A represent the sides with a slit between the same; and by bending the said piece to the proper angle, and affixing the same to a tube or pipe, or other fit receptacle, do form a pen of the same shape or form as represented in Fig. 3. And for the purpose of obtaining a variable degree of hardness to my said pen, when its sides or flat parts are made either of one or two pieces, I do insert the said sides when fixed to a proper receptacle, as described above, into a tube or pipe as represented in Fig. 5; and in this outer tube the pen may be drawn backward or forward, so as to alter the stiffness of the spring, by suffering a less or greater part of the sides to protrude beyond the support of the outer tube at E: and F represents an end section, where the dark shaded parts denote the aperture through which the said sides or parts are thrust. Or, I obtain a greater or less degree of elasticity, by introducing two pieces of wire of an appropriate shape into the cavity formed between the flat sides of the pen and the outer tube, as is shewn in the section at G, which give less or more elasticity, or in other words, make a softer or harder pen as they are drawn backward or forward upon the sides. And, I do make those parts of the flat sides opposed to each other and forming the slit of the pen, rather thicker towards the points in order to prevent the pen from sputtering: this is shewn in Fig. 6, where A B represents one of the sides laying flat, and C D as seen upon its edge, in each of which *a b* denote the part which is made thicker. And I do make my said pen according to the construction hereinbefore described, of steel, brass, silver, gold, or platina, or any other metal or material, fit and proper for making pens.

In witness whereof, &c.

Specification of the Patent granted to DAVID MATHEWS, *of Rotherhithe, in the County of Surrey, Engineer; for an improved Method of constructing and building Locks with an inverted Groin or Gothic Conic Arch, also an improved Form of the Gates, and an improved Method of opening and shutting the same.*

Dated September 7, 1810.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said David Mathews do hereby declare that the nature, purpose, and object of my said invention, hereinafter particularly described, is in the first place to render the construction of locks and lock gates less expensive than heretofore, to diminish the pressure of the water upon the gates, to render the locks less liable to be blown up; and to work the gates with less labour than hath heretofore been used. And I do also declare, that my said invention, and the manner in which the same is to be performed, is particularly described and ascertained in and by this instrument, and the drawing thereunto annexed; that is to say: the form of each of the lock gates, instead of being as usual square or oblong, having the upper and lower edges parallel, will be such that the depths of the gates will increase from the hanging post to the meeting post, making the lower edge a straight line or a curve descending from the lower end of the hanging post to the lower end of the meeting post, as in (Plate VIII.) Fig. 1, where A B C D represents one of the lock gates; A B the hanging post, D C the meeting post, B *b* C the line formed by the lower edge of the gate, and A *a* C the line formed by the section of the body of the lock parallel to the gate; by this means the construction of the gates is less expensive, from their not requiring to be equally strong and not taking so much timber; also the pressure against the gates is much diminished, on account of the surface exposed to the fluid being less than hath heretofore been; and by that means the pressure against the side walls is also less than in the case of the common lock gates. The gates will shut against a sill in the form of the lower edge of the gates, which sill will project a little way beyond the termination of the body of the lock, so as to receive with the hollow quoins the whole pressure of the gates. The body of the lock will terminate on each side in a plane parallel or nearly so to the gate on that side when shut, at a convenient distance from the gate, as in Fig. 2, where O F C E represents the termination of the body of the lock, parallel or nearly so to the gate M;

P G A D, the termination of the body of the lock parallel or nearly so to the gate N; K I is the part of the sill projecting a little beyond the plane O F E C, to receive the pressure of the gate M; H I is the part of the sill projecting beyond the plane P G A D, to receive the pressure of the gate N; the front of the sill is represented by the black line K I H; the two parts of the sill form a groin arch. The lower edges of the gates, instead of running on a platform as usually constructed, will move a little above a surface of brick or stone, which in form has the figure which is swept out by the lower edges of the gates in opening, but is placed a little below them. In the Fig. 1. if *m n* be a line a little below the lower edge of the gate, and having exactly the same form, and *m o* be the axis on which the gate turns produced, the surface above-mentioned will be for the gate A B C D the surface traced out by the line *m n*, if the plane *m n o* revolve about *m o*, and in the same way for the other gate. If the lower edge of the gate be in a straight line it will be a regular conical surface, if a curved line it will be a curved conical surface; by this means the body of the lock and the sill form an arch terminating in the groin arch, the strength of which is opposed to any effort of the water to blow up the lock, and the construction of the conical or curved surface renders it unnecessary to make a platform in the usual way, which is a considerable saving of expense. Upon the above-mentioned surface a circular rib of iron is raised, having the same centre with that on which the gate turns; on which rib the gate will turn by means of a roller. The rib will be most conveniently placed, so as to be always under the centre of gravity of the gate, and motion will be communicated to the gate by means of a pinion and rack segment, whose centre will also be the centre of the gate's motion. One end of the rack segment will be fastened to the back of the gate, the other end will run into the wall by means of a culvert, having a corresponding circular direction to meet the pinion, which will be turned by a capstan at the surface of the ground. The rack may be fastened to the bottom of the gate, and may be supported by rollers running on the circular rib, continued into the wall as far as is necessary; or the rack may be fastened to the centre of the pressure of the gate, and may be constructed of wood and iron, or iron cast hollow, so as to be as near as may be of the specific gravity of the water. In Fig. 3, A B represents a section of the gate at the place where the rack segment is fastened; C D is the rack segment; C fastened to the gate; and the end D running into the end of the culvert, and meeting the pinion, E placed below the surface of the ground; A B F represents the conical surface a little below the lower edge of the gate; G H represents the other gate half open. In Fig. 4, A B C D represents the culvert running circularly into the recess wall in which the rack segment moves, or *a b c d* will represent the same when the rack segment is applied higher up in the gate. Fig. 5 represents the appearance at the surface B C; C D the gates shut; A and *a* the shafts of the spindle which connect the capstan and pinion. Fig. 6, represents the capstan drum-head, bars, spindle, and pinion, G being the pinion. Or the motion may be communicated by substituting, for the rack segment, an iron segment of a circle, with a chain to it, and passed once round a roller, which in the place of the pinion C, ribbed vertically to create motion. This chain is to be sunk in the outer edge of the iron segment, to prevent its assuming the form of a straight line. In Fig. 7, part 1, A B represents a rib of the lock gate; C, the place where the iron segment is fastened to the gate; C F E the iron segment; *c f* D *e* the chain running once round the roller D. In Fig. 7, part 2, the capstan, spindle, and roller are represented; *g* is the roller with the chain passed once round it. By both these modes fewer hands will be required to work the gates than according to the old method.

In witness whereof, &c.

On some Exotics which endure the open Air in Devonshire.

By A. HAWKINS, *Esq.*

From the TRANSACTIONS of the HORTICULTURAL SOCIETY of LONDON.

THOUGH I have no knowledge of the Horticultural Society but through the medium of extracts in the last Monthly Review, (which first informed me of its existence,) yet struck with your "*Hints respecting the proper Mode of inuring tender Plants to our Climate,*" and residing in the very warmest part of England, (the South Hams of Devonshire, of which I am a native,) within view of an inlet of the sea, I am led to state to you some facts, that, perhaps, may not be wholly unworthy of notice.

In October, 1795, a CAMELLIA JAPONICA was planted here, among other shrubs, in the open ground; it has stood every winter since, without the smallest shelter, thrives well, and has never had a branch or leaf injured by the weather; it is now about four feet high, the size of a gooseberry bush, but has not flowered.

Pl. VIII. Vol. XVIII. Second Series.

Fig. 5.

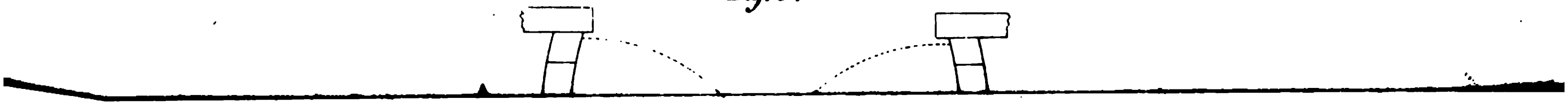


Fig. 3.

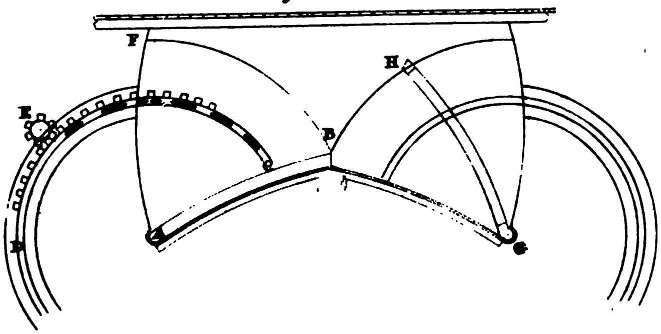
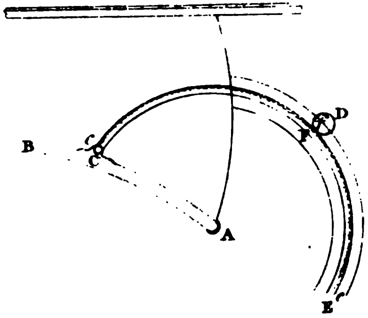


Fig. 7. part 1.



Two plants of the FUCHSIA COCCINEA were planted out four years ago under a brick wall, facing the outh. At first the branches suffered by the frost, but ey put forth new shoots in the spring, with much rength, and have flowered well every summer. During e two last years I was absent, but I understand that ly the extremities of the branches were injured, and ey have always flowered in great perfection.

Some plants of the SOLANUM PSEUDO CAPSICUM, or MOMUM PLINII, are also under a brick wall, (but not iled against it,) which have stood many years, and ly a small part of the very extremities of their branches s been injured by frost.

MYRTLES of every kind (even the double-blossomed d orange) do exceedingly well in the open ground, ough the *Silver*, from the richness of the soil, soon comes plain.

The BUDDLEIA GLOBOSA likewise stands the climate, d some of the plants are ten feet high, spread wide, d make a handsome appearance. One of them is aced in a situation open to the North-east winds, here the sun cannot shine during the short days, yet it s stood there since 1794, and never had more than e extremities of the branches hurt.

About two miles from my house is the small sea-port wn of Salcombe, just between those two well-known ints, the Prawl and Bolt-head; the latter of which is the parish whence this letter is written, a place that e sea washes on three sides. Perhaps of all spots in e British isles, Salcombe is the very first for climate d shelter. The celebrated Doctor Huxham used to ll it the Montpellier of England. In 1774, a large MERICAN ALOE, only twenty-eight years old, and which had always stood in the open ground, without covering, flowered there; it grew to the height of twenty-eight feet, the leaves were six inches thick, and nine feet in length, and the flowers, on forty-two branches, innumerable.

Several plants of the VERBENA TRIPHYLLA are growing at Salcombe in the open ground, and are now six feet high. I have not tried any of them myself; but as I expect to be more at home in future, than for some years past, I shall not fail to add this plant to those tender shrubs already growing around me.

Oranges and Lemons, trained as peach trees against walls, and sheltered only with mats of straw during the winter, have been seen in a few gardens of the South of Devonshire for these hundred years. The fruit is as large and fine as any from Portugal. Some lemons, from a garden near this place, were about thirty-five or forty years ago presented to the King by the late Earl Poulett, from his sister Lady Bridget Bastard, of Gerston; and there are trees still in the neighbourhood, the planting of which I believe is beyond memory. The late Mr. Pollexfen Bastard, (uncle of the M. P. for Devon,) who had the greatest number of oranges and lemons of any one in this county, remarked, above thirty years since, (what tends to confirm your experiments,) that he found trees raised from seed, and inoculated in his own garden, bore the cold better than oranges and lemons imported.

Researches on the oxymuriatic Acid, its Nature and Combinations; and on the Elements of the muriatic Acid. With some Experiments on Sulphur and Phosphorus, made in the Laboratory of the Royal Institution.

By H. DAVY, *Esq. Sec. R. S. Prof. Chem. R. I. F. R. S. E.*

(Concluded from Page 103.)

THE compound formed by burning phosphorus in oxymuriatic acid, is in a similar relation to water: if that substance be added to it, it is resolved into two powerful acids; oxygen, it may be supposed, is furnished to the phosphorus to form phosphoric acid, hydrogen to the oxymuriatic acid to form common muriatic acid gas.

None of the combinations of the oxymuriatic acid with inflammable bodies can be decomposed by dry acids; and this seems to be the test which distinguishes the oxymuriatic combinations from the muriates, though they have hitherto been confounded together. Muriate of potash, for instance, if M. Berthollet's estimation of its composition approaches towards accuracy, when ignited, is a compound of oxymuriatic acid with potassium; muriate of ammonia is a compound of muriatic acid gas and ammonia, and when acted on by potassium it is decompounded: the oxymuriatic acid may be conceived to combine with the potassium to form muriate of potash, and the ammonia and hydrogen are set free.

The vivid combustion of bodies in oxymuriatic acid gas, at first view, appears a reason why oxygen should be admitted in it; but heat and light are merely results of the intense agency of combination. Sulphur and

metals,

[illegible] ignited during [illegible] might be ex- [illegible] of oxymuriatic [illegible] bodies.

[illegible] arguments in favour of [illegible] nature of an acid [illegible] the general analogy [illegible] metals, to the [illegible] strictly [illegible] existence, and [illegible] with as much force [illegible] that the neu- [illegible] with water; and the [illegible] in the case of [illegible] the metal [illegible] and a basis [illegible]

[illegible] hydrogen evolved during the [illegible] gas by metals is the [illegible] produced during the decomposition [illegible] appears, at first view, an [illegible] of water in muriatic [illegible] one known combination of [illegible] acid, one quantity must [illegible] Hydrogen is disengaged from its oxymuriatic combination by a metal, in the same manner as one metal is disengaged by another from similar combinations; and of all inflammable bodies that form compounds of this kind, except perhaps phosphorus and sulphur, hydrogen is that which seems to adhere to oxymuriatic acid with the least force.

I have caused strong explosions from an electrical jar to pass through oxymuriatic gas, by means of points of platina,

tina, for several hours in succession; but it seemed
to undergo the slightest change.

I electrised the oxymuriates of phosphorus and sul-
ar for some hours by the power of the Voltaic appa-
ts of 1000 double plates; no gas was separated, but
inute quantity of hydrogen, which I am inclined to
ribute to the presence of moisture in the apparatus
ployed; for I once obtained hydrogen from Libavius's
uor by a similar operation; but I have ascertained,
t this was owing to the decomposition of water ad-
ring to the mercury: and in some late experiments
de with 2000 double plates, in which the discharge
s from platina wires, and in which the mercury used
confining the liquor was carefully boiled, there was
production of any permanent elastic matter.

As there are no experimental evidences of the exist-
ce of oxygen in oxymuriatic acid gas, a natural
estion arises concerning the nature of these com-
unds, in which the muriatic acid has been supposed to
ist, combined with much more oxygen than oxymu-
tic acid, in the state in which it has been named by
r. Chenevix, hyperoxygenised muriatic acid.

Can the oxymuriatic *acid* combine either with ox-
en or hydrogen, and form with each of them an
id compound; of which that with hydrogen has the
ongest, and that with oxygen the weakest, affinity
r bases? for the able chemist to whom I have just re-
rred, conceives that hyperoxymuriates are decomposed
y muriatic acid. Or, is hyperoxymuriatic acid the
sis of all this class of bodies, the most simple form of
is species of matter?

The phænomena of the composition and decomposi-
on of the hyperoxymuriates may be explained on
either

either of these suppositions; but they are mere suppositions, unsupported by experiment.

I have endeavoured to obtain the neutralizing acid, which has been imagined to be hyperoxygenised, from hyperoxymuriate of potash by various modes, but uniformly without success. By distilling the salt with dry boracic acid, though a little oxymuriatic acid is generated, yet oxygen is the chief gaseous product, and a muriate of potash not decomposable is produced.

The distillation of the orange-coloured fluid, produced by dissolving hyperoxymuriate of potash in sulphuric acid, affords only oxygen in great excess, and oxymuriatic acid.

When solutions of muriates, or muriatic acid, are electrised in the Voltaic circuit, oxymuriatic acid is evolved at the positive surface, and hydrogen at the negative surface. When a solution of oxymuriatic acid in water is electrised, oxymuriatic acid and oxygen appear* at the positive surface, and hydrogen at the negative surface, facts which are certainly unfavourable to the idea of the existence of hyperoxygenised muriatic acid, whether it be imagined a compound of oxymuriatic acid with oxygen, or the basis of oxymuriatic acid.

If the facts respecting the hyperoxymuriate of potash indeed be closely reasoned upon, it must be regarded as nothing more than as a triple compound of oxymuriatic acid, potassium, and oxygen. We have no right to assume the existence of any peculiar acid in it, or of a considerable portion of combined water; and it is, perhaps, more conformable to the analogy of chemistry, to suppose the large quantity of oxygen combined with the potassium, which we know has an intense affinity for oxygen, and which, from some experiments, I am inclined to believe, is capable of combining directly with more oxygen than exists in potash than with the oxymuriatic acid, which, as far as is known, has no affinity for that substance.

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* The quantity of oxymuriatic acid in the aqueous solution is so small, that the principal products must be referred to the decomposition of water. This happens in other instances; the water only is decomposed in dilute solutions of nitric and sulphuric acids.

It is generally supposed that a mixture of oxymuriatic acid and hyperoxymuriatic acid is disengaged when hyperoxymuriate of potash is decomposed by common muriatic acid*; but I am satisfied, from several trials, that the gas procured in this way, when not mixed with oxygen, unites to the same quantity of hydrogen†, as common oxymuriatic acid gas from manganese; and I find, by a careful examination, that the gas disengaged during the solution of platina, is a mixture of nitric and muriatic acids, which has been regarded as hyperoxymuriatic acid, but which I stated some years ago to possess the properties of oxymuriatic acid gas ‡, is actually that body, owing its peculiar colour to a small quantity of nitromuriatic vapour suspended in it, and from which it is easily freed by washing.

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* If hyperoxymuriate of potash be decomposed by nitric or sulphuric acid, it affords oxymuriatic acid and oxygen. If it be acted upon by muriatic acid, it affords a large quantity of oxymuriatic acid gas only. In this last case, the phænomenon seems merely to depend upon the decomposition of the muriatic acid gas, by the oxygen, loosely combined in the salt.

† This likewise appears from Mr. Cruickshank's experiments. See Nicholson's Journal, vol. V. 4to. p. 206.

‡ The platina, I find by several experiments, made with great care, has no share in producing the evolution of this gas. It is formed during the production of aqua regia. The hydrogen of the muriatic acid attracts oxygen from the nitric acid. Oxymuriatic acid gas is set free, and nitrous gas remains in the solution, and gives it

Few substances, perhaps, have less claim to be considered as acid than oxymuriatic acid. As yet we have no right to say that it has been decompounded; and as its tendency of combination is with pure inflammable matters, it may possibly belong to the same class of bodies as oxygen.

May it not in fact be a *peculiar* acidifying and dissolving principle, forming compounds with combustible bodies analogous to acids containing oxygen, or oxyds, in their properties and powers of combination; but differing from them, in being for the most part decomposable by water? On this idea muriatic acid may be considered as having hydrogen for its basis, and oxymuriatic acid for its acidifying principle. And the phosphoric sublimate as having phosphorus for its basis, and oxymuriatic acid for its acidifying matter. And Libavius's liquor, and the compounds of arsenic with oxymuriatic acid, may be regarded as analogous bodies. The combinations of oxymuriatic acid with lead, silver, mercury, potassium, and sodium, in this view would be considered as a class of bodies related more to oxyds than acids in their powers of attraction.

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it a deep red colour. *Nitrous* acid and muriatic acid produce no oxymuriatic acid gas. Platina, during its solution in perfectly formed aqua regia, gives only nitrous gas and nitrous vapour; and I find, that rather more oxymuriatic acid gas is produced, by heating together equal quantities of nitric acid of 1.45, and muriatic acid of 1.18, when they are not in contact with platina, than when exposed to that metal. The oxymuriatic acid gas, produced from muriatic acid by nitric acid, I find combines with about an equal volume of hydrogen by detonation.

It is needless to take up the time of this learned Society by dwelling upon the imperfection of the modern nomenclature of these substances. It is in many cases connected with false ideas of their nature and composition, and, in a more advanced state of the enquiry, it will be necessary, for the progress of science, that it should undergo material alterations.

It is extremely probable, that there are many combinations of the oxymuriatic acid with inflammable bodies which have not been yet investigated. With phosphorus it seems capable of combining in at least three proportions; the phosphuretted muriatic acid of Gay Lussac and Thenard is the compound containing the maximum of phosphorus. The crystalline phosphoric sublimate, and the liquor formed by the combustion of phosphorus in oxymuriatic acid gas, disengage no phosphorus by the action of water; the sublimate, as I have already mentioned, affords phosphoric and muriatic acid; and the liquid, I believe, only phosphorous acid and muriatic acid.

The sublimate from the boracic basis gives, I believe, only boracic and muriatic acid, and may be regarded as boracium acidified by oxymuriatic acid.

It is evident that, whenever an oxymuriatic combination is decomposed by water, the oxyd or acid or alkali or oxydated body formed must be in the same proportion as the muriatic acid gas, as the oxygen and hydrogen must bear the same relation to each other; and experiments upon these compounds will probably afford simple modes of ascertaining the proportions of the elements, in the different oxyds, acids, and alkaline earths.

If, according to the ingenious idea of Mr. Dalton, hydrogen be considered as 1 in weight, in the proportion it exists in water, then oxygen will be nearly 7.5: and assuming that potash is composed of 1 proportion of oxygen, and 1 of potassium, then potash will be 48, and potassium * about 40.5; and from an experiment, which I have detailed in the last Bakerian lecture, on the combustion of potassium in muriatic acid gas, oxymuriatic acid will be represented by 32.9, and muriatic acid gas, of course, by 33.9; and this estimation agrees with the specific gravity of oxymuriatic acid gas and muriatic acid gas. From my experiments, 100 cubical inches of oxymuriatic gas weigh, the réductions being made for the mean temperature and pressure, 74.5 grains; whereas by estimation they should weigh 74.6. Muriatic acid gas I find weighs, under like circumstances, in the quantity of 100 cubic inches, 39 grains; by estimation it should weigh 38.4 grains.

It is easy from these data, knowing the composition of any dry muriate, to ascertain the quantity of oxyd or of acid it would furnish by the action of water, and consequently the quantity of oxygen with which the inflammable matter will combine †.

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* Supposing potash to contain nearly 15.6 *per cent.* of oxygen.

† I have stated in the last Bakerian lecture, that during the decomposition of the amalgam from ammonia, 1 in volume of hydrogen to 2 of ammonia is evolved: it is remarkable, that whatever theory of the nature of this extraordinary compound be adopted, there will be a happy coincidence as to definite proportions. If it be supposed that the hydrogen arises from the decomposition of water; then the oxygen that must be assumed to exist in ammonia, will be exactly sufficient to neutralise the hydrogen, in an equal volume of muriatic acid; or if it be said that ammonium is a compound of 2 of ammonia and 1 of hydrogen in volume, then equal

volumes

In considering the dry muriates, as compounds of oxymuriatic acid and inflammable bodies; the argument that I have used in the last Bakerian lecture, to shew that potassium does not form hydrate of potash by combustion, is considerably strengthened; for from the quantity of oxymuriatic acid the metal requires to produce a muriate, it seems to be shewn that it is the simplest known form of the alkaline matter. This I think approaches to an experimentum crucis. Potash made by alcohol, and that has been heated to redness, appears to be an hydrat of potash, whilst the potash formed by the combustion of potassium must be considered as a pure metallic oxyd, which requires about 19 *per cent.* of water to be converted into a hydrat.

Amongst all the known combustible bodies, charcoal is the only one which does not combine directly with oxymuriatic acid gas; and yet there is reason for believing that this combination may be formed by the in-

volumes of muriatic acid gas and ammonia will produce the same compound as oxymuriatic acid and ammonium, supposing they could be immediately combined. I once thought that the phænomena of metallisation might be explained according to a modified phlogistic theory, by supposing three different classes of metallic bodies: First, The metal of ammonia, in which hydrogen was so loosely combined as to be separable with great ease, and which, in consequence of the small affinity of the basis for water, had little tendency to combine with oxygen. The second, the metals of the alkalies and alkaline earths, in which the hydrogen was more firmly combined, but in combustion, forming water capable of being separated from the basis. And, thirdly, the metals of the earths and common metals; in which the hydrogen was more intimately combined; producing by union with oxygen, water not separable by any new attractions. The phænomena of the action of potassium and sodium upon muriatic acid, referred to in the text, seem however to overturn these speculations so far as they concern the metals from the fixed alkalies.

termedium of hydrogen. I am inclined to consider the oily substance produced by the action of oxymuriatic acid gas, and olefiant gas, as a ternary compound of these bodies: for they combine nearly in equal volumes; and I find that, by the action of potassium upon the oil so produced, muriate of potash is formed, and gaseous matter, which I have not yet been able to collect in sufficient quantity to decide upon its nature, is formed. Artificial camphor, and muriatic ether, as is probable from the ingenious experiments of M. Gehlen and M. Thenard, must be combinations of a similar kind, one probably with more hydrogen, and the other with more carbon.

One of the greatest problems in œconomical chemistry, is the decomposition of the muriates of soda and potash. The solution of this problem will, perhaps, be facilitated by these new views. The affinity of potassium and sodium for oxymuriatic acid, is very strong; but so likewise is their attraction for oxygen, and the affinity of their oxyds for water. The affinities of oxymuriatic acid gas for hydrogen, and of muriatic acid gas for water, are likewise of a powerful kind. Water, therefore, should be present in all cases, when it is intended to attempt to produce alkali. It is not difficult after these views to explain the decomposition of common salt, by aluminous or silicious substances, which, as it has been long known, act only when they contain water. In these cases the sodium may be conceived to combine with the oxygen of the water and with the earth, to form a vitreous compound; and the oxymuriatic acid to unite with the hydrogen of the water, forming muriatic acid gas.

It is also easy, according to these new ideas, to explain the decomposition of salt by moistened litharge, the theory of which has so much perplexed the most acute chemists. It may be conceived to be an instance of compound affinity: the oxymuriatic acid is attracted by the lead, and the sodium combines with the oxygen of the litharge and with water to form hydrat of soda, which gradually attracts carbonic acid from the air.

As iron has a strong affinity for oxymuriatic acid, I attempted, to procure soda by passing steam over a mixture of iron filings, and muriate of soda intensely heated: and in this way, I succeeded in decomposing some of the salt: hydrogen came over; a little hydrat of soda was formed; and muriate of iron was produced.

It does not seem improbable, supposing the views that have been developed accurate, that by complex affinities, even potassium and sodium in their metallic form, may be procured from their oxymuriatic combinations: for this purpose the oxymuriatic acid should be attracted by one substance, and the alkaline metals by another; and such bodies should be selected for the experiment, as would produce compounds differing considerably in degree of volatility.

I cannot conclude the subject of the application of these doctrines, without asking permission to direct the attention of the Society, to some of the theoretical relations of the facts noticed in the preceding pages.

That a body principally composed of oxymuriatic acid and ammonia, two substances which have been generally conceived incapable of existing together, should be so difficult of decomposition, as to be scarcely affected by any of the agents of chemistry, is a phænomenon of a perfectly new kind. Three bodies, two of which are permanent gases, and the other of which is considerably volatile, form in this instance, a substance neither fusible nor volatile, at a white heat. It could not have been expected that ammonia would remain fixed at such a temperature; but that it should remain fixed in combination with oxymuriatic acid, would have appeared incredible, according to all the existing analogies of chemistry. The experiments on which these conclusions are founded, are, however, uniform in their results: and it is easy to repeat them. They seem to shew, that the common chemical proposition, that complexity of composition is uniformly connected with facility of decomposition, is not well founded. The compound of oxymuriatic acid, phosphorus, and ammonia, resembles an oxyd, such as silex, or that of columbium, in its general chemical characters, and is as refractory when treated by common re-agents; and except by the effects of combustion, or the agency of fused potash, its nature could not be detected by any of the usual methods of analysis. Is it not likely, reasoning from these circumstances, that many of the substances, now supposed to be elementary, may be reduced into simpler forms of matter? And that an intense attraction, and an equilibrium of attraction, may give to a compound, containing several constituents, that refractory character, which is generally attributed to unity of constitution, or to the homogeneous nature of its parts?

Besides the compound of the phosphoric sublimate and ammonia, and the other analogous compounds which have been referred to, it is probable that other compounds of like nature may be formed of the oxyds, alkalies, and earths, with the oxymuriatic combinations, or of the oxymuriatic compounds with each other; and should this be the case, the more refined analogies of chemical philosophy will be extended by these new, and as it would seem at first view, contradictory facts. For if, as I have said, oxymuriatic acid gas be referred to the same class of bodies as oxygen gas, then, as oxygen is not an acid, but forms acids by combining with certain inflammable bodies, so oxymuriatic acid, by uniting to similar substances, may be conceived to form either acids, which is the case when it combines with hydrogen, or compounds like acids or oxyds, capable of forming neutral combinations, as in the instances of the oxymuriates of phosphorus and tin.

Like oxygen, oxymuriatic acid is attracted by the positive surface in Voltaic combinations; and on the hypothesis of the connexion of chemical attraction with electrical powers, all its energies of combination correspond with those of a body supposed to be negative in a high degree.

And in most of its compounds, except those containing the alkaline metals, which may be conceived in the highest degree positive, and the metals with which it forms insoluble compounds, it seems still to retain its negative character.

I shall occupy the time of the Society for a few minutes longer only, for the purpose of detailing a few observations connected with the Bakerian lectures, delivered in the two last years; particularly those parts of them relating to sulphur and phosphorus, which new and more minute enquiries have enabled me to correct or extend.

I have already mentioned that there are considerable differences in the results of experiments, made on the action of potassium, on sulphur and phosphorus, and their combinations with hydrogen, according to different circumstances of the process. I shall now refer to such of these circumstances as I have been able fully to investigate.

The able researches of Dr. Thomson have shewn that sulphur, in its usual state, contains small quantities of acid matter; and though, in my first experiments, I conceived that by employing crystallized native sulphur, which had been recently sublimed in nitrogen, I should avoid the presence of any foreign matter, yet I am inclined to believe that this is not the case; for by subliming some similar sulphur in nitrogen, I find that litmus paper placed in the upper part of the retort is slightly reddened.

When potassium is made to unite with sulphur, if the retort employed is not lined with sulphur, some of the potassium is destroyed by acting upon the glass; and when large quantities of sulphur are used, it is very difficult to decompose the whole of the sulphuret of potassium by an acid: sulphuretted hydrogen likewise is soluble in muriatic acid; and this circumstance led me to under-rate the quantity of sulphuretted hydrogen given off in experiments of this kind [*].

In acting upon sulphuretted hydrogen by potassium in my early experiments, I used large quantities of the gas and of the metal; and in these cases I have reason to believe, that the violence of the combustion occasioned the decomposition of a considerable quantity of the gas; and, in consequence, led me to form erroneous conclusions concerning the nature of this curious operation.

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[*] This circumstance has been pointed out by MM. Gay Lussac and Thenard; in a paper printed in the Journal de Physique for December, in which these gentlemen endeavour to shew that, whether potassium has been acted upon by large or small quantities of sulphur, and under all circumstances, it evolves a quantity of gas exactly equal to that which it produces by the action of water. I have been able to gain no results so precise on this subject. I have in another place (the same journal in which their memoir has appeared) offered some observations on their enquiries.

In all late experiments in which sulphur, or sulphuretted hydrogen were concerned, I have used muriatic acid saturated wtth sulphuretted hydrogen over mercury. I have employed sulphur distilled from iron pyrites in vacuo, which did not in the slightest degree affect litmus paper, and I have combined it with potassium in retorts of green-glass, or plate-glass lined with sulphur and filled with very pure nitrogen or hydrogen. In making potassium act upon sulphuretted hydrogen, I have employed the gas only in the quantities of from 1 to 3 cubical inches, and have made the combination in narrow curved tubes of green-glass over dry mercury. With all these precautions, and after having made a great number of experiments, I am not able to gain perfectly uniform results. Yet there is a sufficient correspondence between them to enable me to form conclusions, which I may venture to say cannot be far from the truth.

When one grain of potassium, which would give by the action of water about 1 cubical inch and one-sixteenth of hydrogen, is made to act upon about half a grain of sulphur, some sulphur sublimes during the combination, which always takes place with heat and light, and from one-fourteenth to one-tenth of a cubical inch of sulphuretted hydrogen is evolved. The compound acted on by muriatic acid, saturated with sulphuretted hydrogen, affords from nine-tenths to ele-

ven-

ven-tenths of a cubical inch of pure sulphuretted hydrogen.

When more sulphur is used so as to be from twice to ten times the weight of the potassium, the quantity of sulphuretted hydrogen evolved by the action of the acid, is from seven-tenths to nine-tenths; but if heat be applied to the combination, so as to drive off the superfluous sulphur, the quantity of gas collected is very little inferior to that produced from the combination in which a small proportion of sulphur is used; and I am inclined to believe, from the phænomena presented in a great number of experiments, that sulphur and potassium, when heated together under common circumstances,* combine only in one proportion, in which the metal is to the sulphur nearly as three to one in weight; and in which the quantities are such that the compound burns into neutral sulphate of potash.

When a grain of potassium is made to act upon about 1.1 cubical inches of sulphuretted hydrogen, all the hydrogen is set free, and a sulphuret of potassium containing one-fourth of sulphur is formed, exactly the same as that produced by the immediate combination of sulphur and the metal.

When sulphuretted hydrogen is employed in larger quantities, there is an absorption of this gas, and a volume is taken up about equal to the quantity of hydrogen disengaged, and a compound of sulphuretted hydrogen and sulphuret of potash is formed, which gives sulphuretted hydrogen by the action of an acid, nearly double in quantity to that given by the sulphuret of potassium.

From a number of experiments I am inclined to believe that potassium and phosphorus, in whatever quan tities they are heated together, combine only in one proportion, a grain of potassium requiring about three-eighths of a grain of phosphorus to form a phosphuret; which when acted upon by muriatic acid, produces from eight-tenths to ten-tenths of a cubical inch of phosphuretted hydrogen.

Half a grain of potassium decomposes nearly three cubical inches of phosphuretted hydrogen, and sets free rather more than four cubical inches of hydrogen; and the phosphuret formed seems to be of the same kind as that produced by direct combination of the metal with phosphorus.

If, according to Mr. Dalton's ideas of proportion, the quantity in which sulphur enters into its combinations were to be deduced from its union with potassium, in which it seems to form about one-fourth the weight of the compound, the number representing it would be 13.5. I have lately weighed sulphuretted hydrogen, and sulphurous acid gas, with great care: the specific gravity of the first at mean temperature and pressure, from my experiments, is 10645, which differs very little from the estimation of Mr. Kirwan: that of sulphureous acid gas I find is 20967. Sulphuretted hydrogen, as I have shown, contains an equal volume of hydrogen; and on this datum the number representing sulphur is 13.4. I have never been able to burn sulphur in oxygen without forming sulphuric acid in small quantities; but in several experiments I have obtained from 92 to 98 parts of sulphurous acid from 100 of oxygen in volume; from which I am inclined to believe, that sulphurous acid consists of sulphur dissolved in an equal volume of oxygen; which would give the number as

13.7* nearly, considering the acid gas as containing 1 proportion of sulphur, and 2 of oxygen; and these estimations do not differ from each other materially.

I have made several experiments on the combustion of phosphorus in oxygen gas. From the most accurate, I am inclined to conclude that 25 of phosphorus absorb in combustion about 34 of oxygen in weight; and considering phosphoric acid as composed of 3 proportions of oxygen and 1 of phosphorus, the number representing phosphorus will be about 16.5, which is not very remote from the number that may be deduced from the composition of phosphuret of potassium.

The numbers which represent the proportions in which sulphur and phosphorus unite with other bodies, are such, as do not exclude the existence of combined portions of oxygen and hydrogen in their constitution; but it may be questioned, whether the opinion which I formed, that the inflammable gas disengaged from them by electricity, is necessary to the peculiar form in which these bodies exist, is not erroneous. Phosphorus, as I have stated in the last Bakerian lecture, is capable of forming a solid hydruret: and a part of the sulphur

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[*] The estimation from the composition of sulphuretted hydrogen must be considered as most accurate, and that from the formation of the sulphuret of potassium as least accurate: for it was only by combining sulphur and potassium in small proportions, and ascertaining in what cases uncombined sulphur could be distilled from the compound, that I gained my conclusions concerning the composition of the sulphuret of potassium.

In the last Bakerian lecture, I have estimated the specific gravity of sulphuretted hydrogen at 35 grains, the 100 cubical inches, which was not far from the mean, between the estimations of Mr. Kirwan and Mr. Thenard. According to this last experiment, sulphuretted hydrogen is composed of 1 proportion of hydrogen, represented by 1, and 1 of sulphur represented by 13.4.

distilled from iron pyrites, is usually of a soft consistence, and emits the smell of sulphuretted hydrogen, and probably contains that body. It is not unlikely, that in all cases, phosphorus and sulphur contain small quantities of the hydrurets of phosphorus and sulphur; and the production of a minute portion of sulphuric acid in the slow combustion of sulphur, is probably connected with the production of water. Though the pure oxyds of sulphur and phosphorus have never been obtained, yet from the doctrine of definite proportions, these bodies ought, under certain circumstances, to be formed. And I am inclined to believe, that they sometimes exist in minute quantities, in common phosphorus and sulphur, and, with hydrogen, give to them their variable properties.

The colours of different specimens of phosphorus, as well as of sulphur, differ considerably; the red colour of phosphorus, as it is commonly prepared, is probably owing to a slight mixture of oxyd. Common roll sulphur is of a very pale yellow, the Sicilian sulphur of an orange colour, and the sulphur distilled from iron pyrites in vacuo, which arose in the last period of the process, of a pale yellowish green colour. All the late experiments that I have made, as well as my former researches, induce me to suspect a notable proportion of oxygen in Sicilian sulphur, which is probably owing to the presence of oxyd of sulphur, which may give rise to sulphuric acid in distillation, or to sulphuric acid itself.

Conceiving that if definite proportions of oxygen and hydrogen existed in sulphur and phosphorus, they ought to be manifested in the agency of oxymuriatic acid gas on these bodies, I made some experiments on the results of these operations. In the first trial, on the combination of sulphur with oxymuriatic acid gas, I employed 5 grains of roll sulphur, and admitted the gas into the exhausted retort, from a vessel in which it had been in contact with warm water: in this case more than half a cubical inch of oxygen gas, and nearly two cubical inches of muriatic acid gas, were produced. Suspecting, in this instance, that aqueous vapour had been decomposed, I employed cold water in the next experiment, and dried the gas by muriate of lime; in this case, though Sicilian sulphur was used, no oxygen gas was evolved; and not a half of a cubical inch of muriatic acid; the quantity was the same as in the last experiment; and it was found, that between 16 and 17 cubical inches of oxymuriatic acid gas disappeared; the whole of the sulphur was sublimed in the gas, and the liquor formed, was of a tawney orange colour.

No oxygen was expelled during the combustion of phosphorus in oxymuriatic acid gas, nor could I ascertain that any muriatic acid had been formed; 3 grains of phosphorus were entirely converted into sublimate, by the absorption of about 23 cubical inches and a half of the gas.

It would seem from these quantities, that the sulphuretted liquor formed by subliming sulphur in oxymuriatic acid gas, consists of 1 proportion of sulphur, represented by 13.5, and 1 of oxymuriatic gas represented by 32.9, and that the phosphoric sublimate must be composed of 3 portions of oxymuriatic gas, represented by 98.7, and 1 of phosphorus represented by 16.5.

A new

A new and expeditious Mode of Budding.

By THOMAS ANDREW KNIGHT, *Esq. F. R. S.*

From the TRANSACTIONS of the HORTICULTURAL SOCIETY of LONDON.

ARKINSON, in his Paradisus Londoniensis, which as published in 1629, has observed, that the nurseryen of his days had been so long in the practice of subtuting one variety of fruit for another, that the habit doing so was almost become hereditary amongst them: ere we to judge from the modern practice, in some blic nurseries, we might suspect the possessors of em, to be the offspring of intermarriages, between the scendants of those alluded to by Parkinson. He has, wever, mentioned his "very good friend, Master John radescant" and "Master John Miller," as exceptions; d similar exceptions are, I believe, to be found in odern days. It must, however, be admitted, that herever the character of the leaf does not expose the ror of the grafter, as in the different varieties of the each and nectarine, mistakes will sometimes occur; d therefore a mode of changing the variety, or of inoducing a branch of another variety, with great expeition, may possibly be acceptable to many readers of he Horticultural Transactions.

The luxuriant shoots of peach and nectarine trees are enerally barren; but the lateral shoots emitted in the me season by them are often productive of fruit, parcularly if treated in the manner recommended by me the Horticultural Transactions of 1808 *. In the experiments I have there described, the bearing wood was afforded by the natural buds of the luxuriant shoots; but I thought it probable that such might as readily be afforded by the inserted buds of another variety, under appropriate management. I therefore, as early in the month of June, of the year 1808, as the luxuriant shoots of my peach trees were grown sufficiently firm to permit the operation, inserted buds of other varieties into them, employing two distinct ligatures to hold the buds in their places. One ligature was first placed above the bud inserted; and upon the transverse section through the bark: the other, which had no farther office than that of securing the bud, was applied in the usual way. As soon as the buds (which never fail under the preceding circumstances) had attached themselves, the ligatures last applied were taken off, but the others were suffered to remain. The passage of the sap upwards was in consequence much obstructed, and the inserted buds began to vegetate strongly in July: and when these had afforded shoots about four inches long, the remaining ligatures were taken off, to permit the excess of sap to pass on; and the young shoots were nailed to the wall. Being there properly exposed to light, their wood ripened well, and afforded blossoms in the succeeding spring: this would, I do not doubt, have afforded fruit; but that, leaving my residence at Elton for this place, I removed my trees, and the whole of their blossoms in the last spring proved, in consequence, equally abortive.

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* Page 88.

An Essay on the Mathematical Construction of a Plough, which shall offer the least resistance, and which shall turn a Furrow in the best Manner. By Mr. WILLIAM AMOS, *Author of the Theory and Practice of Drill-husbandry; Minutes of Agriculture and Planting, &c. &c.*

With two Plates.

From the COMMUNICATIONS to the BOARD OF AGRICULTURE.

1. *On the Mathematical Construction of a Plough, &c.*

AS horses and oxen, employed in ploughing, are compelled to answer the command of their managers, the managers ought therefore to know the limits of their powers, and the manner of employing them to the greatest advantage. Hence the construction of a plough, and the manner of harnessing and yoking them to it, become important objects to the husbandman's attention; and the mould-board being the most delicate part of a plough, it therefore demands our first consideration.

On the Construction of a Mould-board.

A mould-board may be considered as composed of two inclined planes, one acting in a perpendicular direction to raise the furrow, the other in a horizontal direction to turn it over; upon the proper form of the curve, which a combination of these inclined planes ought to make, the perfection of a plough depends, as the chief resistances are there met with, and must be overcome.

From the property of inclined planes, when the length and height are given, the greater the length, the less the power.

This is the case in ploughs; therefore the longer the mould-board, the less is the power required to raise the furrow.

But it is found that, for general use, a plough, from the share-point to the heel, should not exceed 36 inches, nor should it ever be less than 30; hence the average length will be 33. But I prefer the greatest length for all stiff soils.

If eight inches are allowed for the solid part of the share, the mould-board should be 27+3 = 30. The reason for adding three inches, is to make the tail of the mould-board at the top longer than at the bottom, by taking the three inches off the under edge of the tail diagonally to the hinder extremity at the upper edge.

The height of the mould-board cannot be less than the breadth of the furrow, even upon sward land; but upon broken land it should be three or four inches higher, to prevent the earth from being thrown over the mould-board in waves.

The width of the plough-sole should not be less than the breadth of the furrow; and the width at top is nearly double the width at bottom; as will be demonstrated hereafter.

The proposed width and depth of the furrow must be given, as well as the length of the wooden part of the plough sole; for upon these points depend the dimensions of the block of wood, from which the mould-board is to be formed.

A depth from three to six inches, and a width from eight to ten, are in practice the most general.

From these preliminaries I will suppose the furrow to be nine inches wide, and six inches deep; and the length of the wooden part of the plough sole 27 inches long; then the block of wood, (Plate IX.) Fig. 1, must be 12 inches high from A to B, nine inches wide at bottom from A to D, and the length B Q = 27 + 3 = 30 inches.

The advantages gained in a mould-board of these dimensions are as much as its length exceeds its perpendicular height. And if the mould-board is made to be pressed in every point alike, and to wear no more in one part than in another, it will raise the furrow, and turn it over with less power than any other form.

In order to obtain that form, and the curve, which a combination of the two inclined planes ought to make, the perpendicular height, and the horizontal width at top, must be equally divided by a diagonal line proceeding from the left hand lower corner of the fore part, to the right hand upper corner of the hind part, of the block of wood from which the mould-board is to be formed.

The great advantages attending a mould-board of this form are,—that the land is ploughed in the best manner possible, and with the least loss of power; (the rise and twist being easiest toward the forepart of the share, where the greatest resistance obtains;) and that the furrows are so laid, as to present the greatest surface possible to the influences of the sun and atmosphere, and to furnish the greatest quantity of mould for covering the seed. This method of constructing it may be executed by any person, and by a mathematical procedure so exact, that its form can never vary the breadth of an hair; and the execution of it is as easy as it is certain.

But, however easy it may be to perform, when a person has once seen it done, yet a considerable degree of difficulty attends the description. But before I proceed to this part, it will be necessary to demonstrate how the extreme width of the mould-board, at top, is found.

In Fig. 1, (Plate IX.) Let A B C D represent a section of the block; and A E F D, a section of the horizontal position of the furrow, nine inches broad by six deep; D G H I will then represent the ascending position of the furrow in equilibrium, where the line D H is perpendicular to the horizon, and passing through *a*, the centre of gravity, divides the furrow into two equal portions.

In this position there is no farther pressure upon the perpendicular inclined plane; but by the least pressure of the horizontal inclined plane, the furrow will fall of itself upon the end D K, and rest in the perpendicular position D K L M, or upon its edge.

From this position it is removed by the horizontal inclined plane pressing upon it at M, which causes it to turn upon the point or corner K, until it arrives at K N O P, the descending position in equilibrium; where the line K O is perpendicular to the horizon, and passing through *a*, the centre of gravity, divides the furrow into two equal parts: when it has passed this position, it will fall of itself.

Hence it is evident that the extreme width at a height only equal to the breadth of the furrow, cannot be less than the aggregate of the breadth and depth of the furrow taken together, *viz.* 9 + 6 = 15 inches, even upon sward land, and which gives this general rule.

$$\mathrm{DM} : \mathrm{ML} :: \mathrm{DT} : \mathrm{TC} + \mathrm{BT} = \mathrm{BC}.$$

$$\text{As } 9 : 6 :: 12 : 8 + 9 = 17$$

inches for the width at top, in a height of 12 inches.

rard furrow is shifted about one inch to the
its rise and twist, on account of its diagonal
parallelism to the mould-board, it will there-
n the position *a*, *b*, *c*, *d*, when it leaves the
and in order that the gravity of the furrow
ses, get the better of its elasticity, the width
be rather increased than diminished. Hence
that the extreme width at top, in a height
cannot be less than 17; for the line D L C
B C, exactly 17 inches from the land side
ne furrow in the position *a*, *b*, *c*, *d*, to fall
er place 1, 2, 3, *c*.

foregoing daigram it is palpably evident that
width of a mould-board at top is entirely
its height, and the depth of the furrow.
ing table shews at one view all the propor-
ry in plough-making.

1	2	3	4	5	6	7	8	9	10	11
Length of the Plough sole.	Length of the solid part of the share.	Breadth of the furrow.	Projection at the height of Fs. breadth = to depth.	Height of the mould-board.	Projection at the top of mould-board.	Breadth of the furrow.	Extreme width at top	Radius of the breast.	Radius of the top.	Per. of breast distant from the toe.
I.	I.	I.	I.	I.	I.	I.	I.	I.	I.	I.
30	8	as 10 :	6 : :	12.	7.8	+ 10	= 17.8	18	34	11.5
			5 : :		6.5	+ 10	= 16.5	18	34	12
			4 : :		5.2	+ 10	= 15.2	19	34	12.5
27	7	as 9 :	5 : :	12.	6.6	+ 9	= 15.6	16	32	11.25
			4½ : :		6	+ 9	= 15.	18	30	11.5
			4 : :		5.3	+ 9	= 14.3	19	28	11.75
24	6	as 8 :	4½ : :	12.	6.	+ 8	= 14.	17	29	10.5
			4 : :		5.5	+ 8	= 13.5	17	30	10.5
			3½ : :		4.8	+ 8	= 12.8	16	30	10.5

EXPLANATION of the foregoing TABLE.

Column 1st. Shews the length of the wooden part of the plough-sole.

2d. Shews the solid part of the plough-share.

3d. Shews the width of the furrows.

4th. Shews the depth, or projection, at a height equal to the breadth of the furrow.

5th. Shews the height of the mould-boards.

6th. Shews the projection at the top of the mould-boards.

7th. Shews the breadth of the furrows, which must be added to the projection at the top, and gives the extreme width of the mould-boards from the land side of the plough, in column 8.

9th. Shews the radius of the circles which form the curves of the breast.

10th. Shews the radius of the circles which form the curves on the outside of the mould-boards at top.

11th. Shews the distance between the toe of the plough, and where the perpendicular of the breast must be erected.

But as the furrows are not only shifted one inch to the right hand, but the plough is also obliged to be biassed a little to the left; the width therefore at top should rather be increased than diminished.

These preliminaries being settled, I shall proceed to describe the method of constructing a mould-board of the least resistance, which should be a continuation of the wing of the share, beginning at its hinder edge, and in the same plane.

A B C D Q R S, is a perspective view of the end, top, and left side of the block of wood from which the mould-board is to be made; in which the height A B is 12 inches, the width at top B C is 17, the width at bottom A D is nine, and the length B Q is 27 + 3=30 inches.

Divide the length of the block into 30 equal parts; then, by a carpenter's square, trace upon all the sides of the block, lines an inch distant from one another, as represented by the occult lines.

Fig. 2, is a perspective view of the end, top, and right side of the block; on the top of which draw the diagonal line C E; and on the right side, draw the diagonal line C H.

Then take a fine-toothed saw and make it enter at E, directing it toward C, and inclining it along the corner line E G, until it makes a right line between C and G (as in Fig. 4.); then make the saw enter at H, and keep the direction H C, inclining it along the base line G H, until it encounters the central diagonal C G (Fig. 4), which had been formed by the first cut; the pyramid C E F G H (Fig. 3.) will then fall off, and leave the block in the form of (Fig. 4.), which clearly exhibits the two inclined planes, and the central diagonal line C G, formed by the division of the perpendicular height and the horizontal width; upon which, and the right side base line D H, the curve, which a combination of these inclined planes ought to make, is formed by straight lines from the bottom edge of the right side of the block across the central diagonal to the breast and upper edge of the mould-board.

Attention must be used, not to confound the lines drawn on all the sides of the block, since they are now separated

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Fig. 1.

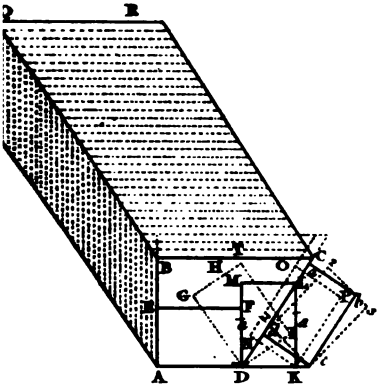


Fig. 2.

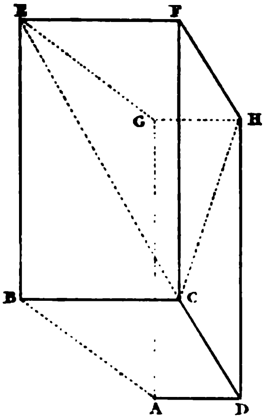


Fig. 4.

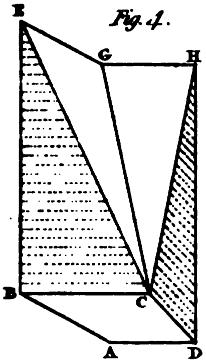


Fig. 5.

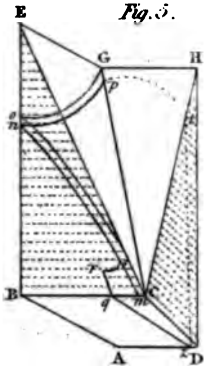
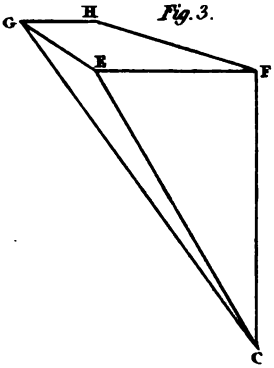


Fig. 3.



separated by the space which the sawing off of the pyramid has left. (Fig. 4.) Make the saw enter upon the two points of the second lines adjoining B C D, which are situated in the places next to the interruption of these lines, and which are nearest to the two points of intersection of the exterior diagonals C E and C H. Then enter the saw, in like manner, on the two proecting points of the second line, or scribe; and saw in, before and behind, till it touches on one part, the central diagonal C G, and on the other part, the right and lower edge of the block D H (Fig. 4.), the fore part of the saw will come out by some point on the top or upper face of the block, in a right line with the corresponding parts of the edge D H and the central diagonal C G. Continue the saw upon all the points formed by the intersections of the exterior diagonals C H and C E, and of the lines marked round the block; always taking the central diagonal C G, and the edge D H for bounds, and the traced lines for directors. You will soon find that the saw, during 19 of these operations, will come out upon the upper face or top of the block, and form the segment of the circle C *b*, equal to 60 inches diameter for the form or curve of the outside of the top of the mould-board.

Continue sawing upon the remaining 11 points, and you will soon find that the saw will appear upon the left side of the block, and form the segment of the circle *b* G, equal to 30 inches diameter, for the curve or form of the breast of the plough. But the angle of meeting of these two curved lines is half way between the 10th and 11th scribe from E.

All these different cuts of the saw will have marked as many right lines; which, beginning from the right [illegible] of the [illegible], will touch the diagonal [illegible] the horizontal inclined [illegible] the face of the perpendicular [illegible]

[illegible] or an adze, take off the [illegible] the surface with a [illegible] the saw marks and the [illegible] which will finish the right [illegible]

[illegible] a gauge trace the lines *m n* on the [illegible] and *p t s* on the bottom, [illegible] mould-board.

[illegible] point next B on the left [illegible] these lines, until the [illegible] the lines *q r*, *s n*, *n p*, and the [illegible] be an inch and a half from the [illegible] C [illegible] G *r*, and D H, or of any [illegible]

When these cuts are all finished, chisel off as before the [illegible], and the mould-board will be finished.

Here it is necessary to observe, that three inches on the left side of the top of the tail of the mould-board next to B, and in the direction of the right handle, should not be sawn so deep, nor chiseled off so much as the rest, in order that the mould-board may be the more easily fitted and fixed to the right handle of the plough, as represented by *m q r s* on the upper side.

In describing this operation, the most simple method is pursued, for the sake of rendering it perfectly easy. But I advise my readers to make a model of the block of wood, from which the mould-board is to be formed, from a scale of three inches to a foot; and to cut the mould-board out in miniature, in order to familiarise themselves with the principle, before they attempt to make a plough.

But mould-boards of cast-iron, half an inch thick, from a model made on the above principles, are preferable, on account of their greater durability and cheapness.

Wooden mould-boards must be sunk, or cut away the fourth of an inch, in order that the form may not be altered by the covering plate-iron on both sides of the plough.

TO BE CONCLUDED IN OUR NEXT.

On preparing Acetate of Potash, so as to obtain it in a saturated State, and of a White Colour.

By Messrs. BERNOULLY *and* FREMY.

From the ANNALES DE CHIMIE.

NINE memoirs were addressed to the Pharmaceutical Society of Paris, in consequence of their offering a prize for the best solution of the above problem. Two only of the memoirs were thought worthy of a particular report being made of their contents, which were those that are here given.

The memoir of Mr. Bernoully, of Basil, commenced with attempting to discover the colouring matter that is so injurious to the appearance of the salt, and which does not belong either to the potash or the acetic acid, so that it must be a foreign matter contained in common vinegar, and carried over with it in distillation. This principle is less volatile than acetic acid, as distilled vinegar leaves a residuum on being evaporated. It is not very soluble itself without the assistance of the acid, as it is

partly

partly precipitated when the acid is saturated with potash. It is evidently of a vegeto-animal nature, from the odour that it exhales upon a burning coal, and from the prussiate of ammonia that is yielded in the distillation of acetate of potash prepared with distilled vinegar, but which does not occur in the distillation of that prepared with radical vinegar. So that the colouring matter appears to be some remains of the yeast left in common vinegar, carried over when it is distilled, and more or less altered by this operation.

The acetate of potash may also be discoloured by the empyreumatic oil with which the distilled vinegar becomes charged when the operation is pushed too far. As to the accidental sullying arising from the oxyds of iron and of manganese contained in the common alkalies, or from metallic vessels being employed in its preparation, it is easily avoided.

In order to get rid of the yeast, it is necessary to choose for distillation clear, very strong, and completely fermented vinegar, and to distill with a very gentle heat, not exceeding that of a gentle boiling heat. If, however, in spite of these precautions, the acetate should not be white, the solution must be gently boiled with well-calcined charcoal previous to evaporation; and this last operation must be conducted slowly.

As to the empyreumatic oil, the distillation of the vinegar must be stopped at the very instant that this oil begins to come over; for although the succeeding vinegar may be perfectly white, it becomes coloured during the evaporation, and when this once happens it cannot be remedied.

Mr. Fremy's memoir enters into more details. In regard to crystallising the acetate, it is extremely difficul-

ty

to separate the crystals from the mother-water; he therefore tried the effects of double decompositions. Acetate of lime treated with carbonate or sulphate of potash afforded a salt of the usual colour. Common acetate of lead and carbonate of soda afforded a salt sufficiently white; but an error in the quantities of the ingredients may be attended with bad consequences. He found that the colour of the acetate proceeds not only from some foreign colouring substance that is contained in the distilled vinegar, but also from the alkali itself when it is in excess, and thus enabled to re-act upon the foreign substance; for on preparing two portions of acetate with the same distilled vinegar, one of which had designedly an excess of acid, and the other of alkali, the latter portion was evidently deeper coloured than the former.

To destroy the colouring matter, he filtered the distilled vinegar upon charcoal, then nearly saturated it with carbonate of potash, and carefully retained an excess of acid during the evaporation, by which means he obtained an acetate as white as if it had been melted.

Although this process is very simple, it is not practicable, because the acetate of potash is mixed with acetate of lime coming from the charcoal, and which is prejudicial to the drying. It would be easy to separate the lime, by adding a slight excess of carbonate of potash, and afterwards adding an excess of the acid; but it is more simple to saturate the acid at first. The liquor being left upon the charcoal for twenty days, and exposed to the sun's rays, furnished a salt still whiter than before; and Mr. Fermy imagines the same effect may be obtained by exposure to the rays of the sun without the addition of charcoal.

Part of the colouring matter is precipitated during the saturation of the vinegar: it is but slightly soluble in water, but some portion of it remains in the solution of the acetate of potash. When distilled vinegar has been filtrated upon very pure charcoal, such as that from sugarcandy, the same precipitate is not obtained as before the filtration.

Two hecatogrammes (6 oz.), of excellent acetic ether, were obtained by rectifying the first produce of the distillation of 70 litres (quarts) of distilled vinegar upon potash.

The discoloration of the acetate by exposing it to the solar rays did not succeed when tried by the Committee to whom the two preceding memoirs were referred.

A gold medal was given to each of the authors, as a partition of the first prize.

Chemical Examination of Woad and Indigo.

By Mr. CHEVREUL.

From the ANNALES DE CHIMIE.

THE two species of plants now to be examined were sowed and cultivated at Paris. The woad was cultivated by Mr. Roard, in a garden near the Gobelins, and the indigo by Mr. Thouin, in the Botanic Garden.

Examination of Woad.

A green, very thick, mucilaginous juice was expressed from 300 grammes (10 oz.) of bruised leaves of woad; the cake being several times opened, sprinkled with water, and again pressed in a cloth. The expressed juice was mixed together in filtres, covered with squares of glass, in order to hinder the contact of the air. A green substance remained upon the filtering paper, which the old chemists have called green fecula.

In order to proceed methodically in this examination, it is necessary to examine successively,

1°. The expressed and filtered juice.

2°. The green fecula.

3°. The cake, which is principally composed of the woody part of the plant.

I. *Examination of the filtered Juice.*

A. It has a yellow colour, inclining to reddish; it was slightly acid: it became greenish by exposure to air, and covered with coppery pellicles. It was filtered afresh twenty-four hours after the first filtering, in order to separate the sediment that was formed in it. A blue substance remained upon the paper, which yielded a purple smoke on being exposed to heat, and also dissolved in sulphuric acid, colouring the acid blue. This substance was therefore indigo, that had been precipitated from the liquor in consequence of having absorbed oxygen.

B. The juice separated from the indigo was reddish, and rather acid: acids separated vegeto-animal matter from it, and produced in it a green colour. This phenomenon indicated the presence of a substance that had been already discovered in indigo from Java, &c. and which was called green matter: alkalis and the alkaline earths changed this colour to yellow, and disengaged ammonia.

The juice being exposed to heat in a China saucer exhibited the following phenomena: at 32° therm. cent. (or 89° Fahr.) small white points became visible, which grew larger by degrees, and formed filaments that crossed each other in all directions. At 48° (118° Fahr.) the coagulation appeared to be complete, the liquid became clear, and of a reddish colour: this was the only change that could be perceived from the action of heat.

This separation of a solid substance from a liquor that is perfectly clear, is a fact worthy of attention. Is it produced by a condensation of molecules caused by a power analogous to that which collects the saline molecules dissolved in a liquid into crystals? or is a substance formed that combines with the animal matter, and renders it insoluble, as happens to cheese in milk that has coagulated without any addition? Without coming to any decision for either of these two opinions, it appears certain that the contact of air is not necessary to the production of this coagulation.

But to return to the properties of the coagulum. It was greenish in some places, and reddish in others: it lost its colour entirely on adding boiling alcohol to it: this liquid dissolved the green matter and a little indigo: in this state the coagulum was white, it became brown on exposure to the air: it was not soluble in boiling water: it melted when exposed to heat, swelled up, and yielded the same products as animal substances: its charcoal left blueish ashes, composed of the phosphates of lime and of iron, carbonate of lime, and a small quantity of silica; the carbonate of lime proceeded from a vegetable calcareous salt that the vegeto-animal matter had carried off along with it: it yielded bitter matter and oxalic acid when treated with nitric acid, and it was dissolved in acetic acid.

C. The liquor B, separated from the vegeto-animal matter by filtration, was evaporated to the consistence of a clear syrup. It deposited during the evaporation, flakes of animal matter, and pellicles of yellow extractive matter. Alcohol was poured upon the evaporated liquor in order to take up whatever substances it might contain that were soluble in that solvent.

The alcoholic solution was of a fine rose colour, and it was acid. It was concentrated, then diluted with water, and again concentrated in order to drive off all the alcohol it might have retained. Towards the end of the evaporation, green matter was precipitated, in the form of a thick oil, which exhaled an empyreumatic and aromatic odour when put upon a live coal; and yielded a puffy charcoal. It was almost insoluble in water; but was soluble in alcohol, excepting a few flakes.

This green matter resembles that described in the paper on indigo. It must however be remarked, that it owes its green colour to its being combined with an acid, and appears to be of a reddish yellow colour when in a state of purity, and red when combined with alkalies or alkaline earths. The following is the method by which it appeared that this substance owes its green colour to acids. A certain proportion of it was combined with potash, and diluted sulphuric acid was poured by degrees upon this combination. The red colour was weakened, and drew towards a yellowish; at this time there was a slight excess of acid; but if the green matter had been of that colour when in a state of purity, it would have appeared of that colour the moment the alkali was saturated, which did not happen: it was necessary to add some more acid to turn it green, which evidently shows that the acid is necessary to give it that colour.

This experiment explains perfectly well the reason that the juice of woad coagulated by heat and filtered has a rose colour, although it contains a slight excess of acid, and why this juice on being treated with alcohol and evaporated, deposits green matter. In the first case, the acid is too much dilated to act upon the green matter, but its power is augmented by being concentrated, and it then forms a green-coloured compound with that substance; perhaps an acid is formed by the action of heat. It is to be presumed that it is acetic acid that produces these phenomena.

Although the name, *green matter*, is an improper designation of this substance, it is here used; but when its properties are better known, a name more expressive of its nature may be given to it.

The liquid separated from the green matter was reddish brown, all the acids changed it to green, and flung down green precipitates; alkalies changed it to red mixed with yellow, because it contained some yellow extractive matter, of which hereafter.

This liquid contained muriate of ammonia, as was discovered by alkalies and solution of silver; also nitre mixed with muriate of potash, discoverable by evaporating it to dryness and treating it with highly-rectified alcohol; besides muriate of ammonia that was taken up, it contained a little acetate of potash, the acid of which might be separated by distilling it with weak sulphuric acid and potash by incineration.

Alcohol therefore extracts from the evaporated juice of woad, 1°. green matter; 2°. yellow extractive matter; 3°. acetic acid, probably, which does not render the green matter green, because it is too much diluted, but which unites with it when concentrated, and falls down with it; 4°. muriate of ammonia; 5°. muriate of potash in small quantity; 6°. nitrate of potash; 7°. acetate of potash.

ash. The nitre and sal ammoniac are in a middling large proportion.

Reagents did not indicate the presence of lime in the alcoholic liquor.

D. The matter insoluble in alcohol, C. was dissolved for the most part in hot water. The solution was reddish, it did not turn green with acids, which shews that it did not contain any green matter; acids changed it to a clear yellow, alkalies to a deeper yellow; alumed silk was dyed in this liquor of a yellow colour, slightly reddish. These experiments show the presence of a yellow colouring matter, which is probably analogous to that which exists in many kinds of common indigo, and in many vegetable juices.

The watery solution contained, in addition to this, a moderate quantity of a vegetable acid salt with base of lime, which will be further examined below. The existence of this salt was shewn by oxalate of ammonia, and acetate of lead. Nitrate of silver was abundantly precipitated by the vegetable acid, and colouring matter; the precipitate did not contain any muriate; nitrate of barytes yielded an abundant precipitate, formed for the most part by the vegetable acid, for the nitric acid left but a very small quantity of sulphate; nutgalls indicated some traces of animal matter.

But besides these substances, there is also some mucilage, which was separated from the yellow-colouring matter, by means of acetate of lead, which precipitated the former. Sulphuretted hydrogen gas was passed through the liquor, which precipitated the excess of lead; it was then concentrated, and alcohol was added, which took up the acetate of lime formed by the decomposition of the vegetable salt, and left a viscous substance of a gummy nature; but it must be confessed, that mucous acid was not obtained from it by treatment with nitric acid.

E. The small quantity of matter that was not dissolved by the hot water in the preceding operation, was of a white colour, and of a crystalline appearance. It was dissolved in water sharpened by nitric acid. This solution was precipitated abundantly by oxalate of ammonia and by fixed alkalies. Ammonia did not occasion any precipitate in it, which shews that it does not contain any phosphate of lime. Acetate of lead produced in it a precipitate formed by the vegetable acid which was combined with lime and magnesia, for on having incinerated a portion of this white matter that had not been dissolved in nitric acid, a residuum was obtained of the carbonates of lime and magnesia; the small quantity of this salt did not permit the acid to be separated, but there is some reason to suppose that it is a citrate, for it has the same appearance as that which Vauquelin and Fourcroy obtained from onion juice, and it was not soluble in boiling water, which is a proof that it was not malate of lime.

Water therefore took up from the juice that had been treated with alcohol; 1°. yellow-colouring extractive matter; 2°. gummy matter; 3°. acidulous malate of lime; 4°. some traces of sulphate of lime. The vegetable salt that did not dissolve was supposed to be citrate of lime and magnesia.

II.

The preceding experiments not having been made with a view of discovering the nature of the vegetable acids that were contained in the juice of woad, and the nature of the volatile principles which might be found in it, the following trials were made in order to attain both these ends.

A. The juice of woad being distilled in a glass retort furnished with a receiver, yielded a white liquid that contained, 1°. a principle, probably oily, that gave it the smell of green French beans; 2°. ammonia, for it restored the colour of litmus that had been reddened by an acid, and it precipitated acetate of lead; 3°. sulphur, for paper covered with carbonate of lead (white lead) being kept in the receiver into which the distillation was made, became covered with black sulphuret. It must be observed, that this paper is a very good means of discovering the presence of sulphur, and that it is much better to hang it up in the void space of the vessels containing the liquids to be examined, than to dip it into the liquids themselves.

It is uncertain whether the ammonia obtained in this distillation, came from the decomposition of any vegetable substance, or from the decomposition of an ammoniacal salt, for example, of acetate of ammonia; this last opinion however appears to be most probable. It is possible that the attraction of certain vegetable substances, especially those that contain azote, for acids, may occasion, or at least favour, by the assistance of heat, the decomposition of ammoniacal salts.

B. Juice of woad distilled with weak sulphuric acid yielded a liquid which contained acetic acid. As the air in the apparatus had the odour of prussic acid, potash was put into the receiver, and green sulphate of iron was afterwards precipitated with this alkali, the precipitate was then washed with weak sulphuric acid, and a blue substance was obtained, which evidently appeared to be prussiate of iron. There can therefore remain no doubt respecting the existence of prussic acid in the produce of this distillation. But does this acid exist ready formed in cruciferous plants, or is it developed by means of heat, and of sulphuric acid? These are questions that cannot be resolved at present, nevertheless the first opinion appears to be by much the most probable.

C. Juice of woad from which the vegeto-animal matter had been separated by heat, was precipitated by acetate of lead; and a curd was obtained in large quantity, of a yellow colour, and formed of the vegetable acid formerly combined with lime (I. D and C), yellow extractive matter, green matter, and a small quantity of vegeto-animal matter that had escaped coagulation. This precipitate, on being decomposed by sulphuric acid, yielded a vegetable acid which possessed the following properties.

Upon evaporation, it became covered with pellicles, which proceeded from the re-action of the acid upon the extractive matter, &c. which was precipitated along with it. The greatest part of this substance was separated from it, by evaporating it several times, and then treating it with alcohol at 40°. The acid thus purified, and left to itself for a month and a half, did not crystallise; on being again dissolved in water, some flakes of yellow extractive matter altered by the acid were still separated, and the liquor possessed the following characters. Lime-water was not precipitated by it, but barytes water was, and the precipitate was totally redissolved in the water. These re-agents gave the acid a yellow colour, because it still retained a little yellow extractive matter. Concentrated potash deepened the colour, and no cream of tartar was produced, although there was a great excess of acid. Nitrate of barytes did not cause any precipitate, but one appeared on adding a drop of ammonia. Muriate of lime yielded a precipitate soluble in cold water. Nitrate of silver, a precipitate soluble in nitic acid. Nitrate of quicksilver, and acetate of lead, white precipitates. The latter was soluble in acetic acid, but it required a certain quantity of the acid.

From these characters it would appear that the acid of the woad which is combined with lime, and is dissolved by water after the juice of woad has been treated with alcohol, is the malic acid.

The liquor being precipitated by acetate of lead, and afterwards treated with sulphuretted hydrogen, was evaporated. When it was sufficiently concentrated, it was put into a cold place, and after some hours, it yielded crystals of nitrate of potash. The mother water of these crystals was reddish, it contained much acetate of lime and acetate of ammonia, acetate of magnesia, acetate of potash, and a muriate. These salts were extracted by means of alcohol at 40°.

The residuum that was insoluble in alcohol was almost totally soluble in water, as only a white matter was left resembling starch, whose nature could not be determined on account of the small quantity of it. Was it not a salt similar to that supposed above to be a citrate? The water had taken up gum, nitre, and lime, but with what acid the latter had been combined is unknown. The reddish colour of the solution did not arise from colouring extractive matter, because the acetate of lead and muriate of tin did not occasion any precipitate in it. It was probably owing to the re-action of the salts upon vegetable matter.

II. Ex-

II. *Examination of the Green Fecula left upon the Paper when the Juice was filtered.*

(a) The greatest part of the green resin was extracted from this fecule by repeated macerations in alcohol while it was fresh. It was afterwards treated several times successively with boiling alcohol; by which means the wax, indigo, and green resin that remained were dissolved. The wax separated on cooling, and the indigo fell down at the end of a few hours. It sometimes happened that the wax drew along with it a little indigo. The following is probably the best method of separating these three bodies. The alcoholic liquor is filtered while boiling, the wax separates from it on cooling, it is again filtered and left exposed to the air, in about 15 or 20 hours the indigo precipitates on the sides of the glass. The liquor is then decanted, and the indigo washed with cold alcohol.

(b) The matter insoluble in alcohol is vegeto-animal matter retaining some indigo and green resin; and its quantity increases in proportion to the dryness of the fecula that is examined. Alcohol cannot dissolve these substances, because they adhere to it by the same power as causes indigo to adhere to woollen stuffs. Besides animal matter, the residuum also contains some remains of the wood of the plant.

When fresh made green fecula is treated with boiling alcohol, the green resin and indigo is taken up, but when the proportion of resin is very considerable, it retains much of the indigo in solution. To discover the presence of indigo in fecula, it may be treated with cold alcohol, in order to dissolve the utmost possible quantity of green resin.

TO BE CONCLUDED IN OUR NEXT.

THE
REPERTORY
OF
ARTS, MANUFACTURES,
AND
AGRICULTURE.

No. CVI. SECOND SERIES. March 1811.

Specification of the Patent granted to RICHARD WILLCOX, *of the Parish of Saint Mary, Lambeth, in the County of Surrey, Mechanist; for sundry Apparatus or Machinery for accelerating the Manufacturing of Felt or Stuff Hats; and for cutting and removing by Machinery the Furs of Beavers, of Rabbits, and the whole Variety of Skins, the Fur or Wool of which is used for the Purpose of Hat-making.* Dated April 3, 1809.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Richard Willcox do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained in the plans drawn in the margin of these presents, and the following explanation thereof; that is to say: My said invention consists of a method of holding down or confining the fur or wool during the operation of cutting or separating the fur from the pelt; and a method of effectually and conveniently removing the same after it is so cut or separated. My method of holding down the fur I thus describe: First, the skin being held down or confined to the surface of the roller on which it is advanced to the knife, I propose to hold or press down the fur by the application of an apparatus, which I call a drag (or some of the other similar suitable contrivances, which will be hereinafter described), moderately pressed on its surface; this is disposed either in a position parallel with or inclined to the axis of the large roller, is placed edgeways or inclined to it, may be composed of iron, of the other simple metals, of a composition of them, or of wood, and is either simple or compounded of different pieces, as the dimensions or other circumstances of the work may occasionally be found to require; and to this I add an apparatus which I call a rake, and by this I propose to remove the fur from off the pelt, after it is separated by the action of the knife; and the drag I construct so as to accommodate itself to and produce an uniform pressure or holding on the fur, notwithstanding its inequalities of thickness; and to produce this, I prefer and adopt an edge bar, pressing with its edge on the fur, and composed of three distinct parts, thus: two outer pieces form a case somewhat similar to that of a pocket comb, and a middle piece is placed between them, and projecting edgewise below them; this I make of about one inch deep and about one eighth thick, and its projection below the case about five eighths of an inch; it is secured to it by two or more rivets, one or two inches from each end, it is filed smooth on the edge which lies in contact with the fur, and this should be a little rounded; by this means the middle piece will, with a moderate degree of pressure, spring on its edge, and so accommodate itself to those skins which are thicker at the middle than the edges, and when of an uniform substance will remain parallel; the materials I find best for this are steel and iron welded together, the steel part in contact with the fur; to remove the fur from the drag I use the rake before-mentioned, and formed either on the principle of the drag, or in other cases, a piece of steel or steel and iron placed edgewise and brought to a knife edge, which is afterwards a little taken down by a file or fine grindstone. One of the methods of applying this apparatus I thus describe: the machinery to work the drag and rake may be any of the well known eccentric motions, as cranks, heart wheels, &c. and connected by any of the well known methods of communicating motion to different shafts; the effects of this apparatus are, that each stroke of the engine the edge of the rake comes into contact with the edge of the drag, and presses on the skin, so as to relieve it in some degree from the weight of the drag (and in some cases the entire weight), and as the rake recedes by the eccentric motion, draws away the fur cut off; the drag now presses on the fur while a second stroke is made, and another portion of fur cut, while the rake is raised by its machinery sufficiently high in its back stroke to be clear of the fur, and fall the next stroke in contact with the drag as before, and is again ready to draw away the fur about to be cut.

The references to the drawings are as follow:

Fig. 1, (Plate X.) A A A A A, the framing of the machine. B B, the large roller on which the skin is disposed, so as to advance the parts to the action of the knife from which the fur is to be cut. C C, is a smaller roller of soft metal, as lead, pewter, &c. on which the fur is cut. D D is the piece which I call the drag, and is already described. Fig. 2 is a front geometrical elevation of it; and Fig. 3 a transverse section. *a a*, are the two pieces which support the springing piece, which is itself shewn in its place below them; the several parts are respectively referred to each other by dotted lines, the rivets of this piece are seen at *b b*. E E E E, is the upper carriage or framing on which is supported the eccentric motions and connection with the drag and rake. F F, are cranks connected to the rake by rods. G G, two eccentric motions connected with the rods F F, for drawing off the rake from the drag. H H I are three chain-wheels connected by a chain *g g g*, to I, which is a handle by which itself and H H are moved, acting on the cranks F F, and eccentrics G G, by which the rake is governed. I, is also set on one extremity of the shaft L, the other end of which has a worm M, which works into the worm wheel N; on the shaft of this and below it is seen a second work O, working into the worm wheel P, set on the axis of the large roller B B, thus setting in motion the roller on which the skin is brought to the action of the knife and the rake; R is the hand knife, with an horizontal and vertical motion, and traversing on the bar S.

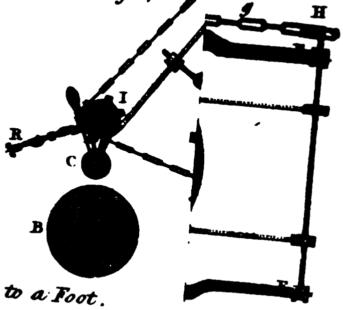
Fig. 4, is a transverse vertical section of the frame E E E E and its apparatus; and Fig. 5, an horizontal plan or bird's-eye view of the same; and in these figures the several parts are respectively marked with the same letters of reference as in Fig. 1.

Fig. 6, shews another method of removing the fur after it is cut. The roller A is the same as that marked C in Fig. 1. B is the drag marked C in Fig. 1. C is a

Pl. X. Vol. XVIII. Second

Fig. 4.

5.

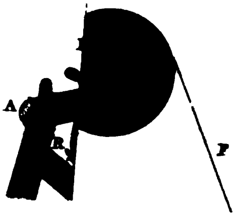


Scale 3/4 to a Foot.

to a Foot.

Fig 1

Fig. 6.



drum roller of about 18 inches diameter. D a metal roller of about 1¼ inch diameter. E a wood roller of 6 nches diameter. About these is an endless web of canvass F F, or other similar suitable material, to which the fur will adhere after being cut from the pelt, and is carried off by the web, as in the former case it was by the rake.

Fig. 7, is an apparatus for the better and more expeditiously plucking the several sorts of furs, &c. A A is a frame, between the uprights of which is set a roller or cylinder B; on one end of this is fixed a wheel C, by which it is turned on its axis, the other end is so tightened by a wedge at E (or other proper contrivance for that purpose), as not to turn unless by the action of the wheel C; the skin is disposed on the cylinder B, and fastened thereto by one edge, by tying or otherwise, is brought over the bar D, and hangs over the front of the cylinder, the operator plucks with both hands, using the two handed knife seen at Fig. 8.

Fig. 9, is the transverse section of an apparatus by which the fur may be cut from the pelt, without employing any apparatus to hold down the skin. A is the large roller as in the former instance. B is the skin attached by one of its edges to the roller at *b*. C is a circular knife revolving on an axis D, by a wheel E, at the same time it traverses the length of the roller A, by the carriage F F, moving on the sliding frame G. H is an arm supporting a small piece I, shewn geometrically at A in Fig. 12; this confines and at the same time turns the fur off the pelt as fast as it is cut, and it falls down on the creeper K K on which it is locked.

Figs. 11 and 12 are respectively front and side elevations of an apparatus for holding down the fur on the roller. In this the dotted circle A A is the circular knife. B B, two small cones so disposed as to be in contact with the surface of the roller, and also with that of a plate C C; they press moderately on the fur by the action of a spiral spring G; one end of this is fixed to the stud H, the other to I; the cones revolve on their respective axes separately by bevel gear affixed to their basis, the apex of each cone is supported by a projecting piece D (Fig. 11.), the corresponding bevel-wheels are set on an upright shaft, driven by a wheel at F, or other suitable and usual contrivance, and I use a single knife in this way, or connect two or more of them as occasion may require. The Figs. 11 and 12 have their several parts marked respectively with the same letter of reference; this apparatus also traverses the length of the roller as Fig. 9, by being fixed on a carriage sliding on triangular bars.

Fig. 10 is a geometrical view of the under side of the circular knife in which the shape, situation, and method of adjusting the piece are shewn; and I declare that the description of the apparatus and their parts herein given is the result of careful and practical experiments, and are what I prefer and adopt in practice; but further I declare, that to prevent the infringement of adopting my principles, or any part or parts thereof, under the disguise of a change of materials, dimensions, or proportions, I claim the privilege of using any or all of the metals or their combinations, of altering my materials, dimensions, or proportions, according to the intended scale of operation (as putting on a portion of a circle or cylinder instead of a whole one, or on an horizontal or inclined bed, &c.). And further, I do not confine myself to any particular mode of connecting my said improvements with the engine, or of communicating motion to them, but adopting all or any of those modes with which mechanics are well acquainted, and claiming as my exclusive right all such copies or approximations to my principles of arrangement and construction herein set forth, as shall clash or interfere with them in any or either of those particulars.

In witness whereof, &c.

Specification of the Patent granted to JOHN ISAAC HAWKINS, *of Great Titchfield-street, in the County of Middlesex, Mechanist; for a certain Instrument, Machine, or Manufacture, applicable in Mechanics as a Balance or Equipoise.* Dated Nov. 2, 1809.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said John Isaac Hawkins do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, is described and ascertained by and in the drawings in the margin of these presents, and by and in the following explanation thereof; that is to say: Instead of a weight commonly used to counterbalance or equipoise a lamp, chandelier, lustre, window-sash, window-shutter, window-blind, sliding-mantle, or blower of a stove, or any other weight requiring a counterbalance or equipoise, I employ a steel spring, such as in a spring-clock is called the main-spring, (see Fig. 1, *a a*, Plate XI). I attach one end of the said spring to a fixed axis *b*, and after coiling this spring around the axis, fasten it by the other end to a barrel *c c c*, which has rotation on the said axis, after the manner the same is done in a spring clock. Now it is well known that if a small weight *d*, be suspended by a line or chain *e*, to the circumference of this barrel, the barrel will be turned a certain small distance, but to make it turn further a large weight is necessary. This spring and barrel is therefore not an equipoise or balance, but requires an addition to constitute it such; for which purpose I fasten to one end of the said barrel a fusee; see Figs. 2, wherein A is a view in a line with the axis; B is a view perpendicular to the axis; *a a* the axis; *b* the barrel; *c* the fusee; this fusee is so formed, that when the spring is slack or nearly slack, and consequently very weak, the line or chain *d*, which supports the weight to be counterpoised (*e*) shall hang near the axis; but as by the rotation of the barrel the spring is wound up and thus becomes stronger, the said line or chain shall recede upon the fusee from the axis, and thereby procure a greater power of purchase upon the spring, and this in such proportion as that the spring shall support any given weight when hung to the line or chain in all situations. The same effect may be produced by fixing the barrel instead of the axis, and letting the fusee with the axis be turned instead of the barrel being turned. This machine may be made of iron, brass, steel, or any kind of hard metal, or some part or parts of metal, and others of wood, or other hard substance; and in order to bring it into action it must of course be fixed in some situation capable of supporting its own weight, and the weight of the thing to be balanced; and the whole machine may be concealed by any covering or ornament which fancy may suggest. In certain confined situations it may be convenient to put

two

Fig. 1.

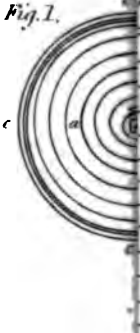


Fig. 7.

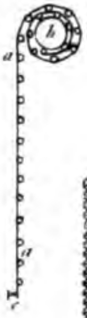


Fig. 5.

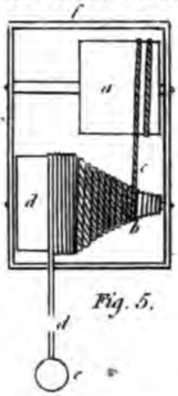
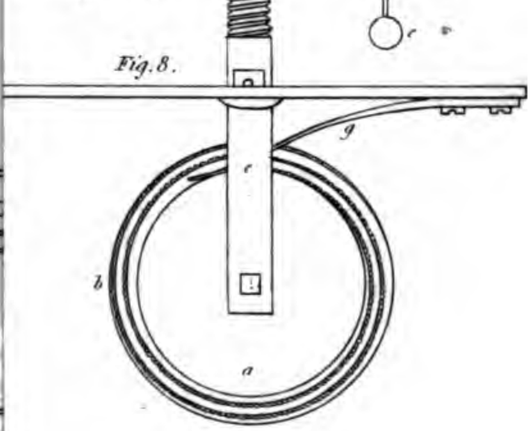


Fig. 8.



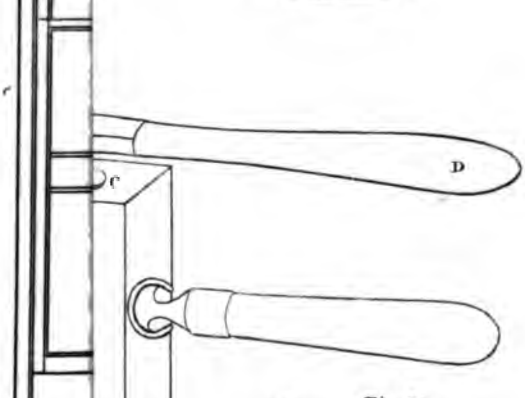
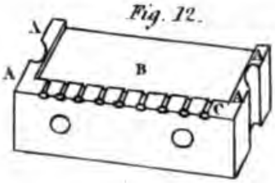


Fig. 12.



two or more machines on one fixed axis, for the purpose of counterbalancing two or more windows, blinds, or weights of any description. For some purposes it will be requisite to have two or more lines or chains, and consequently to make the fusee with double or multiple grooves, Fig. 3; or to have two or more fusees; see Fig. 4, which represents two fusees having a barrel within shewn by dotted lines. For other purposes it may be convenient, as in Fig. 5, to put the spring and barrel *a* on one axis, and the fusee *b* on another, and to employ a line or chain *c* to connect them together, as well as one *d d* going round a cylinder fixed to the fusee, to support the weight to be counterbalanced (*e*); (this line is represented as broken to save room in the drawing;) *f f* is a frame in which the whole acts. For the blower of a stove several plates of iron or brass are to be hinged together and wound on a roller, within which roller is a spring of the kind before-mentioned. In this case since the blower is a variable weight, decreasing as it winds up, and increasing as it is pulled down, the thickness of the blower itself, or of a rim on each edge of it, may form an equivalent to the action of the fusee, by causing the blower to be suspended nearer to or farther from the centre of the roller, in such proportion as to be counterbalanced by the spring at all heights. Fig. 6, represents a front view of the blower; *a a a a* the blower; *b b b b* the hinges; *c c* knobs to move it by. Fig. 7, is a profile view of the same blower partly wound on the roller which forms the axis: *a a* the jointed blower; *b* the roller; *c* the knob. The shape of the fusee must in all cases be determined by the varying power of the spring, and the thickness of the line or chain. A simple rule to find this shape is to take account of the actual weight which the spring will support at every half or quarter turn of the barrel, the weight being suspended from the circumference of the barrel. Multiply this weight by the radius of the barrel, and divide the sum by the weight intended to be suspended from the fusee, the quotient will shew the distance at which the line of such weight is hung from the axis, and consequently will determine the shape of the fusee. In the case of lamps, where the quantity of oil will be greater sometimes than at others, and consequently the weight which is to be supported will vary, I introduce a small spring f, Fig. 1, pressing against the barrel or fusee, or any other convenient part, to create a degree of friction, to prevent the lamp or other weight preponderating when full of oil, and to hinder the counterbalancing spring from being too powerful when the oil is burnt out, or the burner removed, or the weight decreased by any other means: I use the spring to create friction in any case where the counterbalanced weight is liable to increase or diminution. The chief advantage as well as novelty of my invention, consists in combining a spring with a snail or fusee for the purpose of counterbalancing a weight, and as this has not heretofore been done, I claim the right of doing it in all the various forms which fancy or convenience may dictate, a number of which are shewn in the drawings in the margin of these presents, and which are in part before referred to. Fig. 2, shews the machine with single fusee in a convenient form for suspending a lamp, lustre, or other weight. Fig. 6, before referred to, is a view in a line with the axis of the same machine as that shewn in Fig. 2, shewing the end of the barrel, and so much of the fusee as exceeds the diameter of the barrel, the letters refer to the same parts in both figures; *a a*, the barrel; *b b* the fusee; *c* the line or chain to which the lamp, lustre, or weight is to be suspended; *d d* the axis; *e e e e* the frame into which the axis is fixed; *f* a screw for fixing the whole machine to a ceiling or other place. Fig. 10, shews the application of the machine to suspend a window sash; *a* the machine fixed, and to be concealed in the top of the window frame; *b b* the lines coming from two fusees attached to one spring and barrel, which lines go over pullies *c c*; these pullies are fixed to the two extremities of a piece forming the under sides of the top of the window frame; the lines pass down through holes at the end of this piece and fix to the sash *d* on each side; *e e* represent the window frame. In a similar manner I apply the machine to counterbalance a coach window, or other similar weight or weights.

In witness whereof, &c.

Specification of the Patent granted to WILLIAM BUNDY, *of Camden Town, in the County of Middlesex, Mathematical Instrument Maker; for a new Method of heading Pins.* Dated September 28, 1809.

With Engravings.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Bundy do hereby declare that my said invention is fully described and ascertained as follows; that is to say: Fig. 11, (Plate XI.) A, the frame or stock made of metal, in which are fitted a pair of steel dies B, in manner of those generally used for making screws, held together by cylinders C; the dimensions may be various as the quality of work require; the dies I generally use are about two inches long and one inch square; in the prominent parts which appear at A, Fig. 12, and that side of each the two dies which come in contact when in use, (after sinking of a uniform depth a portion of those surfaces as described, B, Fig. 12, to facilitate the following process) are made correspondding grooves, which when pressed together form holes, each the diameter of the shaft intended to have the head fixed on; these holes may be made tapering upward or contracted at that part close under the head, as at C, Fig. 12, where a portion or half a hemisphere, whose diameter being that of the size head required, is to be worked out; viewing the dies thus worked, and in the frame A, Fig. 11, which is the position I place them in while introducing the pointed shafts, each having a head put loosely on, the upper die being at liberty in the frame, the pressure of its weight will be found sufficient to hold the number of shafts with their heads in their respective places, while they are pushed forward with a strait motion, until the quantity of heads prevents the shafts from going any further; in this state it is necessary to turn the lever D, Fig. 11, to which is fixed a screw E, Fig. 13, for the purpose of forcing the dies together, which will hold the shafts firm enough to receive a stroke from a press on the top piece (hereafter described), to secure and form complete the whole number of heads in the dies. Fig. 14 describes the top piece, A the steady pins to fit the holes E, Fig. 11, which will guide those hollows or hemispheres that are sunk in Fig. 14, at B, to match the corresponding portion of hemispheres K, Fig. 11; these hemispheres may be finished to fancy, as respects the ornament or figure of moulding intended for the top of the head, by sinking hem accordingly. I leave a point in the centre of these avities in the top piece, which serves when forced into he top of the shaft to widen it there, and form a rivet, and thereby secure the head firm from coming off the op of the shaft; and the dies having been hard screwed ogether with the lever D, there will be a collar formed by that pressure on the shaft under the head, sufficient to prevent the liability of the head being by any ordinary means forced down the shaft. Now having described the working parts, as in Fig. 11, and admitting he shafts each with a head, are pushed into their respective places at K, Fig. 11, and secured by the screw, Fig. 13, I introduce the steady pins A of the top piece, Fig. 14, into the holes E of the die B, Fig. 11, the hemispheres at B in the top piece Fig. 14, corresponding with hose in the dies at K, Fig. 11, then taking hold of the frame by the handle F, Fig. 11, and placing the whole n a fly press, one stroke therewith on the top piece (the trength thereof being regulated according to the size of the work), will be found sufficient to compleat the whole number of heads in the dies. Hitherto it has been he practice to strike the head several times, and that on its sides expecting to fix it on the shaft while held n a horizontal position. But my method of effectually and securely fastening the heads on the shafts, and leaving the heads of a *superior* form, is, by placing the shafts in a perpendicular direction, and striking the heads and shafts on their tops, which I call *superior heads*, and which method I claim as my invention. To succeed in the completest manner in forming those *superior heads*, it will be necessary that the dimensions of the heads before they are fixed to the shafts, should be particularly attended to; if they are intended when finished, to be nearly of a spherical figure, they should be prepared of a greater depth of axis than the diameter, that the diameter may be small enough to go freely into the hemispheres in the dies and top piece which are to receive them; for this purpose head wire may be made flat, either by drawing or rolling to a size, so that when spun, one or more rounds will be sufficient for a head; I recommend head wire of a smaller than ordinary size without flating, so that when spun and cut three rounds, it shall contain the quantity of metal required for the size head intended. When the heads have been fixed on the shafts by the stroke of the fly-press, the screw is then to be turned back by the lever D, and taking hold of the milled head G, Fig. 11, which is on the head of the small shaft H, and which goes through the screw E, Fig. 13, and is fixed to the top die at I, by being screwed hard in the die B it may be drawn back, to separate the dies sufficiently wide for the *superior headed pins* which they contain, to fall through into some place prepared to receive them.

In witness whereof, &c.

OBSERVATIONS BY THE PATENTEE.

The saving of time by this mode of heading pins is not much; but a great advantage is gained in the superiority of the pins over those made in the common method.

Messrs. Francis and Davidson, of Grace Church-street, (late Durnford and Co.) have purchased the Patent.

Essay on the Mathematical Construction of a Plough, which shall offer the least resistance, and which shall turn a Furrow in the best Manner. By Mr. WILLIAM AMOS, *Author of the Theory and Practice of Drill-husbandry; Minutes of Agriculture and Planting, &c. &c.*

(Concluded from Page 179.)

BUT the easiest and most familiar way to obtain the
rve, which a combination of the two inclined planes
ght to make, (let the dimensions be what they may),
d to represent sensibly the manner in which the fur-
w is raised, and twisted over on this mould-board, is,
r Fig. 1 (Plate XII.), where the board A B C D repre-
nts the sole of the plough nine inches wide, and thirty
ches long inside measure, divided into 30 equal parts,
d scribed with a carpenter's square, as represented by
e occult lines.

A E F B represents the land, or left side of the
lough, 30 inches long and 12 inches deep inside mea-
ure, divided and scribed as the sole; and the board
E G D represents a section of the end of the block of
ood, from which the mould-board is to be made; A E
= 12 inches, E G = 17, and A D = nine inches inside
easure.

Take a strong brass wire, fix one end on a pin in the
ower fore-corner of the land side, bring the wire over
e angle B, and pass the other end of it over the angle G,
ixing it tight in the board A E G D with a nail or wooden
in, as at *a*, to represent the central diagonal line which
ivides the perpendicular height, and horizontal width,
equally.

equally. Take a triangular board represented by E B I, divided and scribed as the other two, and screw on the top, taking care that all the scribes be square with one another, then your model will be finished, which is best made from a scale of three inches to a foot; and then every quarter will be an inch.

Take now a flat iron rule, about five or six inches long, with a straight edge and a sharp point; move it backwards parallel with itself from B C to A D, keeping the straight edge of it always on the line C D, which represents the right side of the mould-board, and letting the point rise as the edge recedes along the diagonal wire B G, which represents the central diagonal, making a prick on every one of the scribes touched by the point on the land side, by which marks or pricks a segment of a circle will be generated of 15 inches radius, for the curve of the breast of the plough.

Continue moving the flat rule backwards, parallel with itself, making a mark or prick on every one of the scribes touched by the point on the top, by which pricks or marks a segment of a circle will be generated of about 30 inches radius, for the right hand upper edge of the mould-board; whose characteristic will be a combination of the principle of the two inclined planes in cross directions, and will give what we seek—the outside curve of a mould-board of the least resistance.

By this machine the foregoing table was constructed. Having by mathematical demonstration, pointed out two easy methods of finding the curve of the breast of the plough, and that of the upper edge of the mould-board, I shall now proceed to shew the advantages that may be derived from the last method.

Instead of using a piece of wood of the full dimensions, the plough-maker needs only to make the sheath or breast of the plough as already described in making the mould-board, *viz.* the segment of a circle of 15 inches radius, to fix the wrest in the usual way, so that the sole or bottom of the plough may be eight inches and three quarters wide all the length; then to apply another piece of wood of a proper length, depth, and thickness, for the other part of the mould-board, on the top of which must be drawn a circle of only 29¾ inches radius to allow for the covering plate iron, and then to work in straight lines from the right lower edge of the mould-board to the circle on the left edge of the breast, and to the circle on the right upper edge of the top, which will save much wood and labour, and the principle of the mould-board will remain the same.

On the Construction of the other essential Parts of a Plough.

In order to determine the position and dimension of the other essential parts of a plough, it is necessary to know the inclination of a horse's shoulder, the height of the point on the shoulder where the traces or chains are yoked to, the length of the chains or traces and swinging trees from that point to the beam end, and the depth and width of the furrow at which the land is required to be ploughed.

The inclination of a horse's shoulder varies in different horses, and in different attitudes. When a horse is standing still, the medium angle is about 69 degrees; but when he is in the act of pulling, the inclination of his shoulder is about 75 degrees: hence the medium angle is about 72 degrees, and the medium height of the point of draught, on the shoulder of a horse 15 or 15½ hands high, is about 48 inches.

When horses are yoked double to a plough, the length of their traces is from 76 to 84 inches, and the length of the chains of the swinging trees from 22 to 26; the medium length will be 104 inches to the beam end.

These data being obtained by admeasurement, nothing more is necessary than to determine the width and depth of the furrow at which the land is to be ploughed; and for the present purpose, I will suppose the depth to be five inches, and the width nine.

These data being settled, I shall now proceed to the geometrical construction of the land, or left-hand side of a plough.

Plate XII. Fig. 2, is a geometrical construction of a plough (en profile) and of the horses properly harnessed and yoke to it. This part of the plough may be considered, as composed of two levers, one of which is the handle, and acts as a lever of the first kind, the fulcrum being at the heel of the plough between the power and the handles, and the weight being on the share. The other lever is the beam, which is of the second kind, the end of the beam being the point where the power is applied, the weight being on the share, and the heel of the plough the fulcrum.

Draw the ground line A B, and at A erect a perpendicular. Set off 48 inches from A to C for the medium heighth of the point of draught on the horses shoulder.

Then with the chord of 60 degrees as radius, describe the semicircle D E F, which divide into twice 90 degrees, as *per* figure.

From C, through 72 degrees, draw the right line G C H, to represent the inclination of the horse's shoulder.

From C draw another line at right angles to the former:

mer, to meet A B in I, which will give the fore part of the plough sole, (147.73 inches from A.) the centre of gravity, or point of resistance, and the line of draught equal to 155.3 inches from C to I. And this will hold good in all well-constructed ploughs, of whatever kind they may be.

When the line of draught is perpendicular to the inclination of a horse's shoulder, the collar will act upon the whole shoulders, and consequently injure them in the least degree: and, moreover, such a direction of the line of draught combines the weight of the horse with his muscular force, which in any other mode of harnessing will in some degree clash with one another.

Set the length of the traces $Cf = 80$ inches $+$ the length of the swinging chains $fK = 24$ inches $= 104$ inches from C to K, which will give the fore end of the beam, or point of draught, in which f is a section of the small swinging trees, and G a section of the great one.

Let fall a perpendicular from K upon A B, which will give the height of the fore part of the beam end K L, equal to 16.099 inches; but the height of the beam end will be more or less, as the traces are longer or shorter.

Draw a line parallel to A B, at the distance of two inches and a half = to half the depth of the furrow (on account of one horse going on the land, and the other in the hollow furrow) as M N.

From the point N, where it intersects the line of draught C I, let fall a perpendicular upon A B to O; which will give the point of the share about 8.11 inches from I, the centre of gravity.

From the point N draw another line, making an angle of 45 degrees with A B, which will give the position of the fore edge of the coulter N P.

In order to prove the foregoing dimensions, and to find out the rest, we have in the triangle A C I,

A C = 48 inches
∠ A C I = 72 degrees.
∠ A I C = 18 ditto.

To find the other two sides. Thus,

As the sine of the ∠ A I C = 18°
Is to the log. of A C = 48 inches,
So is the sine of the ∠ A C I = 72°
To the log. of A I = 147.73 inches.

Again,

As the sine of ∠ A I C = 18°
Is to the log. of A C = 48 inches,
So is radius ———— 10.
To the log. of I C = 155.3 inches.

And as the triangles I K L, and I N O, are similar to the triangle A C I, we have,

As C I = 155.4 inches
Is to A C = 48 ditto,
So is C I—I K = 51.3 ditto
To K L = 16.099 ditto, the height of the beam end. But if the traces, &c. are only 102 inches, the height of the beam end will be 16.5; and if only 100 inches, the height will be 17.05, and the beam lengthened in proportion.

Again,

As A C = 48 inches
Is to A I = 147.73 ditto,
So is K L = 16.099 ditto
To I L = 49.33 ditto.

Again,

As A C = 48 inches
Is to A I = 147.73 ditto,

So is N O = 2.5 ditto.

To I O = 8.11 ditto, the solid part of the share.

Then from I L = 49.33 inches.
Take ' I O = 8.11 ditto.

Gives L O = 41.22 ditto.

And A I = 147.73 — I L = 49.33 = A L = 98.4 ditto.

Set 36 inches from O to Q, and it will give the length of the plough-sole.

On Q erect a perpendicular, and draw the line Q *r*, which gives the heel of the plough, fastened with wooden pins and iron spikes, as *per* figure, or by the iron bolt *c d*.

Upon the point I erect another perpendicular, on which set seven tenths of an inch from I to R.

Set 10½ inches from I to S, there erect another perpendicular; set off 12 inches from S to T for the height of the breast. With a radius of 15 inches, described by the circle R T, then draw the line O R to the tangent of that circle, which will complete the form of the breast of the plough.

Draw the line U S six inches from T, completing the form of the sheath, which should have a shoulder on the land side to bring it into the same plane with the left side of the plough sole, and left handle, and must be bevelled off in the breast from the land side, to answer the curve of the mould-board.

Draw the line *a b* parallel to A B, at the distance of 36 inches; then take six feet in your compasses, and with one foot in S make a mark on *a b* as at V, which gives the length and height of the plough handles.

The beam should be about four inches and a half square, from a little before and behind the coulter hole, tapering towards the beam end, and the left handle;

and it should have a curve five or six inches up and down, as *per* Fig. to prevent the stubble from accumulating under it.

The length of the beam is known by measuring between K and X, about six feet eight inches long.

K and Y is a profile of the bridle and chain-hook, which moves on the bolt *e* as a centre passing through it and the beam, and is fixed in any position by another bolt which passes through the circular head of the bridle Y, (see *b*, Fig. 3.) so as to give the plough a greater or less hold of the ground, which regulates the depth.

But regulating by the bridle will seldom be necessary in ploughs constructed upon the above principles; as the difference of the depths to be ploughed may be sufficiently varied, by lengthening or shortening the line of draught C K, either by the traces C *f*, or by taking up or letting out the links of the swinging chains *g* K, and in particular cases by both.

In order to represent the other parts of this plough, it will be necessary to give a horizontal view of it.

Plate XII. Fig. 3, is a horizontal view of this plough, in which A B represents the land side.

C, is the part where the beam is inserted into the left handle.

E D, the land side of the plough sole.

D E F G, the form of the sole or bottom of the plough.

H, represents the upper edge of the mould-board, which according to the former models, is a segment of a circle of 30 inches radius.

I K, the two handles.

E L, The beam, which should be straight on the right side, and tapered on the left or land side both ways, from a little before and behind the coulter hole (as *per* Fig.), where it is four inches square; and it should be three inches broad at the fore-end, and three and a half deep.

The fore-end of the beam should also make an angle of about 1.25 inches with the land side of the plough sole, as will appear by the following demonstration.

Set off 24 inches (the length of the swinging trees) from the beam end to A. Through A, draw the line P Q at right angles to A B, then set off 9 — 5 = 14 inches (for the width and greater half width of the furrow) from A to P, for the path of the horse in the furrow.

Set off 24 inches from P to Q, for the path of the land horse; then divide P Q into two equal parts, as at R; draw the line D R, which will give the angle to be made by the middle of the beam ⊙ with the land side of the plough sole D E, equal to about 1.25 inches, or two inches at A R.

The reader will observe, that the occult parallel lines between these two ploughs, are to make the dimensions of the latter correspond with those of the former.

M, The bridle of the plough, is 14 inches wide, with notches to receive the hook of the tow-chain of the swinging-trees, as *per* figure.

By shifting this hook to the left hand you take land from the plough, and by shifting it to the right hand you give it land, which serves to counteract any occasional tendency of the plough either to the right or left.

Plate XII. Fig. 4, is the profile of a plough used in the fens of Lincolnshire, constructed upon the same principles as the former.

In this plough I have introduced the wheel-coulter, which is far superior to the standing coulter, upon land that is free from stones.

A horizontal view of this plough being exactly similar to the other, a description and drawing of it would be superfluous.

Plate XII. Fig. 5, is a section of a standing coulter in its full size, and in the form of an isosceles triangle, each side of which is three inches broad, and the base is half an inch thick in the middle of the length of it, tapering towards the point, and thickening a little towards the upper end of it.

That the coulter may have a perpendicular position, and cut in the same plane with the land side of the plough, it should be so placed that a right line, laid along the land side of the plough after it has been plated, may pass along the middle of the coulter's back; in order therefore that it may preserve a perpendicular position, the middle of the coulter hole in the beam should be exactly perpendicular to the land-side of the plough sole, as *per* figure.

But if the form of the beam will not admit the coulter hole to be in this position, without injuring it, the coulter should be kneed below the beam, just so much as to give it a perpendicular position.

Plate XII. Fig. 6, is a section of the socket, or hind part of the share, which receives the toe of the plough, in which A B is seven inches, A C five, and B C eight, inside measure.

Plate XII. Fig. 7, is a horizontal view of this share, in which A B is 15 inches, B C 9½, A C 17.75, and B D 20, and is very suitable for all soils free from gravel and stones; but in stony soils, the fin of the share must be made as narrow as possible: indeed, some land is so stony as not to admit of any fin.

This

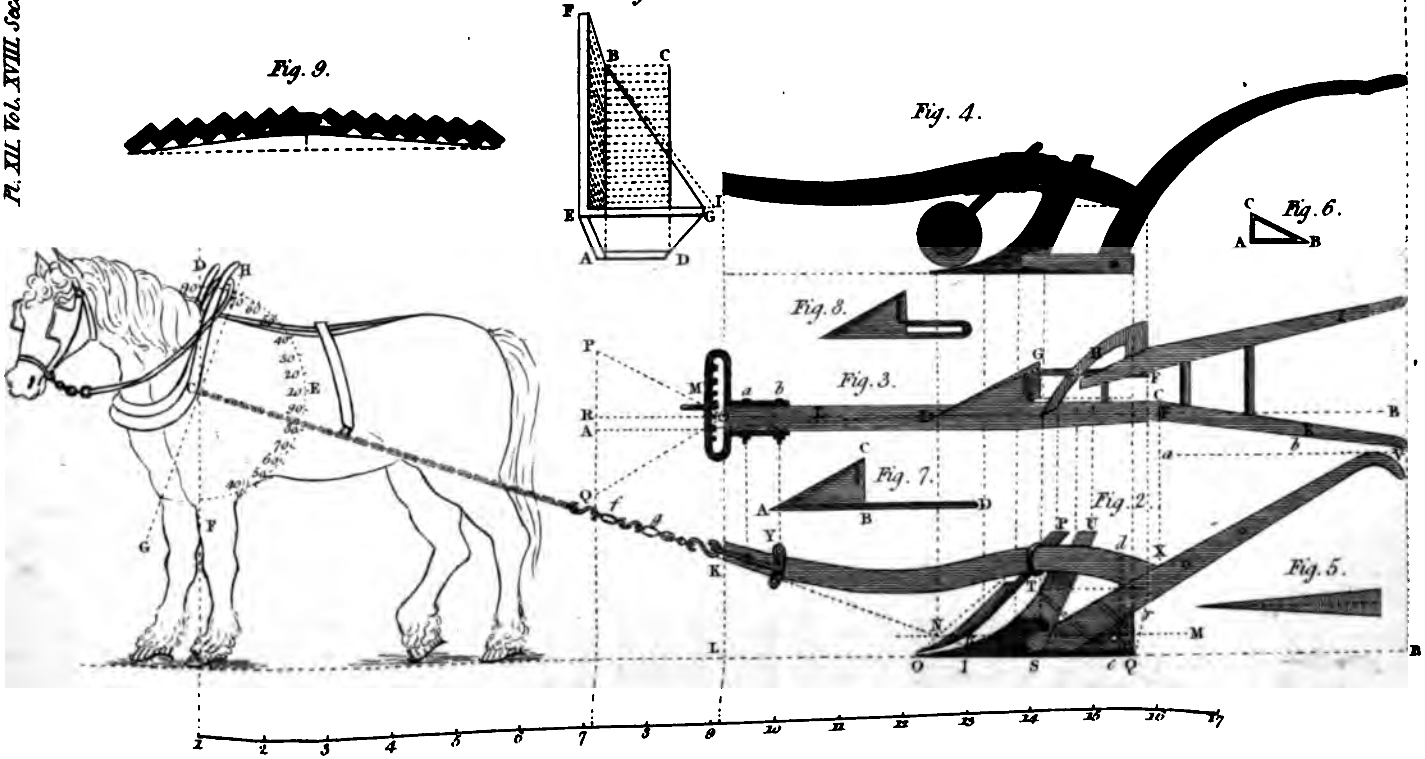


Fig. 9.
Fig. 1.
F
B
C
E
G
I
A
D
Fig. 4.
Fig. 6.
C
A
B
D
H
90
80
70
60
50
40
30
20
10
E
C
G
F
P
R
A
M
O
f
g
K
Y
L
a
b
Fig. 3.
Fig. 8.
Fig. 7.
A
B
C
D
G
H
F
C
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B
a
b
V
Fig. 2.
P
U
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T
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S
e
Q
Fig. 5.
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share is fastened to the breast by a bolt, which
into a nut let into the hinder edge of the sheath,
g. 2.

land side of this share is continued throughout
ole length of the plough-sole, and is fastened by
bolt at *c*. For a profile of this share, see Fig. 2.

XII. Fig. 8, is a horizontal view of a fen share,
of the same dimensions as the other, but fastened
ole of the plough by a perpendicular bolt, as *per*
and the breast by a horizontal bolt the same as
er share.

share being employed for the purpose of cutting
ing the furrow, the curve which it ought to form,
r to perform these operations with the least re-
, will be best obtained from the directions given
ting the mould-board and share, Fig. 2.

the shares may be made true, and all of one
t is expedient to have them forged upon a model
f cast iron, of the same shape with the toe of the
board and sheath, upon which the share is to be
But that the surface of the share may be even
e surface of the plated mould-board, and land
the plough, the wood upon which the share is
must be cut or sunk so much lower than the
the thickness of the share iron exceeds the thick-
the plate iron that covers the mould-board and
de of the plough.

ing thus described the construction of all the es-
parts of a plough, upon the truest mathematical
les ever presented to the public, I shall now pro-
point out the criterion of good ploughing; the
which, though very extensive, may be fully com-
ded in the breaking up of sward; the perfection

of which is to expose the greatest surface possible, and to furnish the greatest quantity of mould for covering the seed.

Plate XII. Fig. 9, is a section of a ridge 12 feet wide, properly ploughed in furrows nine inches wide and four inches and a half deep, laid down from a scale of $\frac{13}{20}$ of an inch to a foot.

Here it is evident, that not only the surface is increased, but also the depth of the staple, which greatly extends the pasture of plants.

The perfection of this mode of ploughing depends on the similarity of the furrows, and on holding the plough steady; for if one furrow be narrower or broader than another, they cannot fall in the true order, as *per* figure.

Since the purpose of ploughing is to expose the greatest surface to the influences of the sun and atmosphere, and to furnish the greatest quantity of mould for covering the seed, it follows that the furrow which shews the greatest surface, must *cæteris paribus*, be the most capable of answering those purposes most effectually. And it is evident from the property of right angled triangles, that the furrow whose depth is about two thirds of its width, and laid to make an angle of 45 degrees with the horizon, will expose the greatest surface possible, and produce the greatest quantity of mould.

On the fertilizing Effects of Gypsum in the United States of America; with a View to elucidate its mysterious Operation, and to extend its Benefits to England, and other Parts of the British Dominions.

By A. FOTHERGILL, *M. D. F. R. S. Hon. Member of several Med. Phil. and Agric. Societies.*

From the COMMUNICATIONS to the BOARD of AGRICULTURE.

GYPSUM, the alabaster of the antients, now commonly termed sulphat of lime, or plaster of Paris, by the moderns, is found in various parts of the world. In England it is found in Derbyshire, Somersetshire, and Devonshire, and probably exists in many other parts of England, and also of Ireland. It is a compound fossil, consisting of sulphuric acid 30, pure calcareous earth 32, water 38, according to M. Chaptal; and it requires 450 times its own weight of boiling water to dissolve it. By calcination it loses 20 *per cent.*; and in that state, when incorporated with water, forms the well-known composition for modelling and statuary, and yields with sand a cement impervious to water, when applied instantly at the time of mixing.

It is precipitated by fixed alkalies, but not by the volatile in a caustic state. When pure it does not effervesce with acids. It powerfully promotes putrefaction, whereas lime resists it, although it dissolves organised bodies.

Of gypsum there are five species, which vary according to their purity and degree of neutralization; hence the analysis of Bergman, Chaptal, and other chemists, differ as to the proportion of the respective ingredients — as a manure, the fibrous or laminated sort is deemed the best. It assumes various colours from other minerals: it is often semi-transparent, very brittle, and may be scraped with the nail of a finger. From the above properties, it would seem a very unpromising substance for a manure; and yet, what is remarkable, most plants, on analysis, yield gypsum. Nor is this more wonderful than that they should be able to digest carbon, nay even silex, or real flint, supposed to be totally insoluble in water! How little do we yet know of the mysteries of the vegetable economy! In the year 1768, the Rev. Mr. Meyer, of the canton of Bern, by a fortunate accident, discovered the fertilising power of gypsum, and liberally disclosed the secret to the neighbouring farmers. To their great surprise, experiments soon convinced them of its efficacy, which they considered as little short of magic. Its fame spread through Germany, and at length reached their German friends in Pennsylvania, where Judge Peters, after subjecting it to various trials on different soils, candidly communicated to the public the result of his experiments. This first brought it into notice in America, and contributed not a little to extend its benefits to the remotest parts of the Union. From his information till the year 1797, and from that of others till the present time, may be collected the result of what is yet known on the subject, and which I shall endeavour to comprise in the following sketch, so far at least as to comprehend the principal leading facts.

Although gypsum has been discovered in the state of New York, and probably abounds in many other districts, yet it continues to be imported in large quantities from Nova Scotia, some from France, though perhaps chiefly as ballast, as it can be had at half a dollar a bushel *. Both sorts are thought to answer equally well; yet such samples as undergo, on exposure to heat, the quickest ebullition, and emit the strongest sulphurous fumes, are generally preferred. Such is the increasing demand, that it is sometimes carried from the wharfs on the banks of the Delaware, above 150 miles by land carriage. It is prepared for use by first pounding it into very small pieces, and then grinding it in a mill, so as to measure 20 or 25 bushels *per* ton. The mill-stones employed for this purpose, it is hoped, will not in future be used for grinding grain. For want of this precaution, two fine horses are supposed to have perished; large calculous concretions having been afterwards found in their intestines. Hard waters, which are considered so injurious in cases of stone and gravel, owe their hardness to invisible particles of gypsum, and which, on evaporation of the water by boiling, deposit those stony incrustrations, so often found in tea-kettles. To a similar origin may be referred those gypsous petrifactions and sparry crystals found in subterraneous caverns, and which serve to adorn our grottos. But to proceed—gypsum affords a cheap and durable manure, and of easy management. When used freely, after the rate of five or six bushels to an acre, its fertilizing effects are found to last six or seven years, though sometimes not very apparent till the third year. Some find it answers better in the proportion of a single bushel every year, with an entire intermission every fourth year. Others think two bushels annually but a small proportion; but this will vary according to the state of the soil. The finer the gypsum is powdered the more speedy is its operation, but the less durable. Its action, being modified by the weather, and sundry minute circumstances, appears mysterious, though its effects are visible,

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* The quantity imported *per annum* into this port alone has been computed to amount to 12,000 tons — a proof of the estimation in which it is held. Thus it is become an article of commerce, as well as of agriculture and statuary.

"Causa latet, vis est notissima."

The mode of using it, is to moisten the seed-grain with water, and then roll it in the pulverised gypsum, which is called coating it; in which state it is sown in the ordinary way. When used as a top dressing, it is also strewed with the hand, as in sowing grain, which is a very uncertain method. Were the drill husbandry generally adopted in this country it would not only facilitate the labour, but disseminate the coated grain, with the utmost regularity, and produce superior crops, with a much smaller proportion of seed, which would soon amply compensate the expence of the machine, and introduce a capital improvement in cultivation.

Some experienced agriculturists allege that gypsum ought not to be applied during the cold of winter, while plants are in a torpid state, but should have the first sprinkling when the young shoots begin to appear, and a second when vegetation is more vigorous, but not too late in the season, lest the gypsum should injure the grazing cattle. Others, however, prefer the winter season, and apply this manure even while the ground is covered with snow.

It is generally believed, though not without some exceptions, that gypsum fails near the sea, and in all cold clayey soils, like that at Mount Vernon, which explains why General Washington's experiments, though varied in different modes, and proportions, from one to twenty bushels *per* acre, proved uniformly unsuccessful. A moist climate, a marshy soil, and one abounding with iron ore, have also been deemed unfavourable.

Judge Peters, after twenty-five years experience, informs us that the soils to which it is most congenial, are the light, dry, sandy, and loamy; and that on strong clay it yields no benefit. That it succeeds best after stable manure and green crops ploughed in. That it promotes the growth of leguminous crops, also the plants of kitchen gardens, fruit trees, Indian corn, the various grasses, but particularly red clover. That it should be applied from the beginning of February till April, and if the weather be foggy or hazy it succeeds the better. That as a top dressing, it is most beneficial in spring, when plants are active, and imbibe their food. That it answers well after lime and alkaline manures; and that cattle seem to prefer the herbage above that which is raised from other kinds of compost. That it speedily converts straw and other vegetable substances into manure; and, by quickening the growth of grain, stifles and overpowers weeds.

Chancellor Livingston, from his experiments, draws the following inferences. 1st. That gypsum in small quantities produces no visible effect on wheat or rye. 2d. That it is beneficial to Indian corn and flax on dry sandy land. 3d. That it is peculiarly adapted to clover in dry soils, and even in wet soils in a dry season. 4th. That crude limestone pulverised has similar effects with gypsum, but requires to be applied in nearly double quantity. 5th. That sea air is unfavourable to gypsum.

Mr. Ely informs the Society of Agriculture at Boston, that gypsum after stable manure answered best. That having sowed early Virginia wheat, at the rate of three bushels *per* acre, on exhausted land, which he manured with gypsum, it yielded above forty bushels *per* acre, of fine grain, which weighed sixty-four pounds *per* bushel, and which ripened before the earliest rye. He had, as usual, sowed red clover with the wheat. He farther observes, that land sprinkled with pulverised gypsum renders it unnecessary to give cattle any salt, according to the usual practice of the inland counties. That near the sea they want none; the sea air supplies its place, but is unfriendly to this manure. This, he concludes, may serve as a criterion for situation as to gypsum.

Mr. Binns, a farmer in Loudon county, Virginia, relates, in his publication in 1803, that he began the use of gypsum twenty years antecedent to that period, and had found it a very rich manure; and that if the seed be coated with it before it is sown it will succeed in any soil, and that such samples as are soft, and melt in the mouth like sugar, are best, and speediest in their operation. That it renders wheat luxuriant, and increases the crop at least threefold; and moreover protects it from the fly, and sheep from the rot; the best remedy for which, he thinks, is red pepper and salt, probably meaning the capsicum, from its red pod. His grounds manured with gypsum, and well rolled, he alleges, have produced Indian corn, an ear of which yielded nearly a quart of grain, clover about four feet high, and other grasses in great abundance. In testimony of Mr. Binn's extraordinary success with gypsum, several farmers have given him their certificates, with their respective signatures.

As the fertilizing power of gypsum is increased, and rendered more lasting by stable manure, wherever the latter is wanting, as in new settlements, it is advisable to turn in the turf, which will supply matter sufficient for several years digestion; and in this way, it is said, the use of gypsum may be perpetuated without losing its effect. Land will probably continue for ever productive by manuring, if the tillage be varied by a proper rotation of crops.

Of the effects of gypsum on the principal bulbous roots, American authors appear to be silent, though this, in the British dominions, may ere long prove an interesting subject of inquiry, particularly as to the great branches of the turnip and potatoe husbandry.

Objections to its Use.

Thus the concurrent testimony of practical authors, who have hitherto written on the subject, seems to afford indisputable proof of the fertilizing power of gypsum, however they may differ as to its management and particular application. Some, indeed, have started the following objections to its use, the only material ones I have yet met with, *viz.*

1st. That its application long continued renders the soil too stiff under the plough, and, by increasing the resistance, retards its progress, and of course makes the labour more difficult.

2d. That it renders crops of grass, particularly clover, too rank and luxuriant.

3d. That by its stimulant power it forces vegetation, and exhausts the soil.

4th. That its supposed utility being confined to particular spots requiring a dry climate, dry soil, light loam, and upland situation, to the exclusion of all places and grounds of an opposite character, and particularly such as border on the sea, low meadows, and all soils abounding with rich clay, or iron ore, render its advantages, if any, entirely local, and extremely limited.

Now some of these objections, if well founded, will appear weighty, but may nevertheless, I presume, be easily removed.

1st. The increased stiffness of the soil only proves that gypsum had been carried to excess, or perhaps applied to land that did not require it. In either of which cases the remedy is easy. In a light porous soil, incapable of retaining moisture, the firm texture complained of would prove a real advantage.

2d. Too great luxuriancy only argues the abuse of a rich manure, as in the preceding article. If it be an evil, it is one of those which rarely occurs from other manures, and instead of being depreciated, is often earnestly solicited. It may, however, be readily remedied, by mowing early, and by repeating it as occasion may require.

3d. That gypsum possesses a stimulant power, by which it greatly accelerates vegetation, may be granted; but is not this property common to every substance that merits the name of manure? That this property may be abused, and carried to excess, has been already admitted. From analogy, therefore, it seems possible that vegetables, as well as animals, may be overfed, and even die of repletion; a circumstance that may sometimes, though perhaps very rarely, happen. But that gypsum, when used with common prudence and moderation, ever exhausts the soil, no proof has yet occurred, and the ablest agriculturists, after thirty years' observation, deny the fact. On the other hand, they furnish many instances of exhausted farms being completely restored by this manure.

4th. The objectionable articles under this head appear to result from conclusions too hastily drawn from partial experiments, and therefore lie open to many exceptions; for were they strictly just, they would present insurmountable obstacles to the successful application of gypsum, in many parts of England, Scotland, Ireland, and even of America. First, as to soils: a strong clayey soil is deemed very objectionable; and yet, in such soil, in hilly or rising ground, which admits of a depending drain, gypsum has proved very beneficial. Few soils, indeed, are wholly without a mixture of clay: the same may be observed of iron; the ores of which, in various forms, abound every where, insomuch that it, perhaps, would be difficult to find a tract of land entirely exempt. Besides, Mr. Binns assures us, that he has employed gypsum with success in every kind of soil. A climate liable to much rain, or moisture, has been also accused as very unfriendly to this manure; and yet writers allege that it answers best when applied in hazy or moist weather. Mr. Moor, in his late tract on the errors of husbandry, expressly declares it very seldom succeeds till a quantity of rain has fallen. The great humidity generally attributed to the British climate has been often alleged as the chief cause which militates against the introduction of gypsum into that country. The average quantity of rain, however, which falls annually in Philadelphia, considerably exceeds that which falls in London; and yet in the country, to a vast extent round Philadelphia, gypsum, though exposed to frequent torrents of rain, still retains its fertilizing power, and is employed with undiminished success. Without a due portion of water, it would seem impossible, indeed, that such solid bodies as gypsum,

lime-

lime-stone, and flint, should be fit to enter into the composition of plants, or promote the process of vegetation.

As the British soil abounds with lime-stone, this has been brought by an eminent writer as another objection against the introduction of gypsum into English culture; but the German farmers at Lancaster, and other parts of Pennsylvania, where lime-stone prevails, nevertheless employ this manure with great advantage, and on this kind of soil many think it answers the best.

Whether even the sea-air, impregnated with the marine acid, be so highly inimical to gypsum, as has been generally imagined, may probably be justly doubted, especially since we are informed, that not only in New Hampshire, but in the State of Main, on lands bordering on the ocean, it is found to succeed very well. Also at Stamford, on mere necks of land projecting into the sea, gypsum has for several years past been applied with very obvious and beneficial effects. Even on the southern coast of England it is reported to have been lately tried with the desired success.

Its mysterious Operation — Whether inexplicable?

It doubtless will be demanded by the inquisitive reader, whence proceeds the fertilizing power of gypsum? — a problem which, perhaps, has never yet been satisfactorily solved. Does it act in its native concrete state, by attracting dew and retaining moisture round the plant, as most writers allege? This seems improbable, as it shews no such property, when fully exposed to the open air, more than marble or other stony concretes *. When deprived of its acid and water of crystallisation by calcination, then indeed it powerfully absorbs moisture; but this decomposition is found to destroy, in a great measure, its fertilizing effects as a manure.

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* To determine this with precision, I made the following experiment. An ounce and an half of gypsum in fine powder, during three foggy

Were its effects dependant on the absorbent property, it would still prove far inferior to slaked lime, soap leys, and other alkaline or absorbent manures, which imbibe moisture with avidity. Is it from its power of promoting the speedy dissolution of vegetable substances, as supposed by some eminent chemists? This is a more probable supposition; but even granting it this property, in a certain degree, yet, in this respect, it is allowed to be inferior to quick lime, and caustic alkali, though much superior as a manure.

Some contend that it cannot act in substance, but remains inert till it undergoes a decomposition. Admitting this for a moment, yet how is the decomposition brought about? Water alone cannot effect it; nor perhaps even alkalies, in the mild state, without culinary heat. Is the decomposition performed by the intervention of an adventitious *hepar sulphuris*, occasionally formed in soils, as Lord Dundonald imagines? This, however, can only take place in certain favourable situations, where sulphur and caustic alkali, or pure earth, are present; and even then, in opposition to carbonic acid, which abounds in all soils, and soon neutralises caustic alkalies and pure earths, which therefore cannot remain long in the caustic state. Besides, the process for *hepar sulphuris* demands a much higher temperature. There is, however, one unsuspected agent contained in vegetables, which has the sin-

foggy nights, was exposed to the open air, in order to receive the dew. On being afterwards carefully re-weighed, it was found to have gained not quite half a grain.

gular power of expelling the sulphurous acid from its calcareous base, and consequently of decomposing gypsum: I mean the saccharine, or, as it now called, the oxalic acid — a circumstance which has wholly escaped the noticé of writers on agriculture, though it might have enabled them to unravel the mystery, in so far as related to the decomposition of gypsum, by a simple, though unexpected agent. But whether its decomposition be absolutely necessary to its success as a manure, may be justly called in question; since M. Hassenfratz, and some of the ablest modern chemists, assure us that lime, silex, iron, and carbon, in other words charcoal, are imbibed by the absorbent vessels of the fibrous roots of plants, merely by a previous solution in water; why may not gypsum, which is easier of solution than most of them, enter in the same way? If they are capable thus of being imbibed in the concrete state, though in particles inconceivably minute, and in union with water, their previous decomposition, so strongly insisted on, becomes wholly unnecessary, nay even injurious, as appears from calcination, page 228. If water, aided by the warmth of the soil, and of the solar rays, be sufficient to accomplish, though by very slow and imperceptible degrees, the solution of gypsum, what reason can be assigned, why it may not be absorbed by the surrounding plants? May not even the slowness of the process, in performing a gradual solution, be the secret cause which contributes to its excellence and durability as a manure, and which gives it a decided superiority over other saline or neutral compounds?

If, according to modern chemists, carbon be allowed to be a constant food of plants, why may not gypsum (which is also found in their composition) sometimes furnish a salutary repast? Or, perhaps, rather as a stimulant, serve to excite appetite or quicken digestion? If this be the principle of action in gypsum, as I conceive it really is, it must tend to simulate vegetables to imbibe an increased quantity of nourishment. May not this explain why it produces the most luxuriant crops on soils replete with the succulent juices of fresh stable manure, and green crops ploughed in?

From what has been said, it would seem to appear, that the use of gypsum has hitherto been circumscribed within too narrow bounds. May it not, therefore, deserve a fair trial in England and Ireland, notwithstanding their insular situation, their rich calcareous or clayey soils, and their exposure on all sides to the sea air? Its success would doubtless crown our harvests with more plenteous crops: even its entire failure might add somewhat to our present stock of knowledge. To bring the matter more speedily to the test, permit me respectfully to propose to the Honourable Board the following experiments, as proper subjects for an honorary premium, if, on consideration, they should meet with their approbation.

1st. To determine, by experiments, the effects of pulverified gypsum on wheat, on a dry loam, in an upland situation, remote from the sea; observing to sow a similar quantity, at some distance from the first, without gypsum, to serve as a standard.

2d. A similar experiment, under the like circumstances, on the sea coast, marking, however, the effects of the sea air on the neighbouring crops and trees.

3d. To determine the comparative effects, in both situations, of powdered lime-stone, quick lime, pit coal, and charcoal *, noting carefully the progress and general result.

4th. Their effects on rye, barley, clover, and other grasses, might also deserve a course of experiments, performed in similar situations, and at their respective seasons.

5th. Sulphat of iron and martial pyrites are beginning to be introduced into agriculture, and, according to report, with promising success: for although simple metallic substances retard vegetation, yet their oxyds and compounds have been found to promote it. These might afford a subject for an additional experiment in both situations. It is scarcely necessary to add, that the state of the weather, the prevailing winds, the quantity of rain, and the weight of the produce, should be carefully observed.

Some writers attribute the efficacy of gypsum wholly to its sulphuric acid, which implies the necessity of the acid being first disengaged by decomposition; but the injurious effects of decomposition appear from what has already been observed of its calcination. It seems, however, very singular, that the sulphuric acid should be deemed so salutary, and the marine acid so pernicious, while experiments seem to prove the reverse. My ingenious friend, the late Dr. Ingenhawz, indeed once entertained very sanguine hopes from the sulphuric acid in promoting vegetation, by supplying oxygen or vital air to the plants; in consequence of which various experiments were instituted with this acid, in various states of dilution, on sundry seeds and plants. But what was the result?—On many it produced no visible effects; on

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* Also calcined gypsum.

some, a dwindling growth; others it wholly destroyed: after sundry trials it was at length given up. A more effectual method of supplying vital air in vegetation, would be to employ a medium to which oxygen is most loosely attached. For instance, the oxygenated muriatic acid, well diluted with water, which, according to Baron Humboldt's experiments, powerfully increased the vegetation of garden cresses. He adds, that Professor Potel, at Dreden, found, by experiments, that seeds, which had many years been kept in a cabinet in a dried state, were brought to vegetate by this active stimulant, the plants raised from which seeds were to be seen in 1793 in a flourishing state at Vienna.

He found the following easy method of applying it to answer his expectation. Let black oxyd of manganese in powder be formed into a paste with water, on which pour the diluted marine acid, after the rate of three cubic inches of water to one of the acid; the vessel to be slightly covered, otherwise it might burst. Place it in a degree of 95 of temperature, which completes the oxygenation. The oxygenated gas, by passing through the seeds, placed on gauze over the vessel, speedily excites their vegetative principle into action, and accelerates germination. This also requires farther experiments to establish so curious a fact; especially as sea air abounds with marine acid and oxygen, and yet is generally allowed to be inimical to vegetation; and the dwarfish appearance of many plants on the sea-coast, seems to justify the opinion.

Though the virtue of gypsum can neither be attributed to its sulphuric acid alone, as some imagine, nor its supposed power of communicating oxygen, as others contend, yet is there not reason to conclude, agreeably to what has been already advanced, that it must first undergo a perfect, though very slow solution, effected by heat and moisture, and that in this state it is conveyed into the constitution of vegetables by a gradual absorption? That being friendly to vegetation in general, it discovers its nutritive and invigorating power, by increasing the fibrous roots and lateral shoot of plants, and by displaying a healthy verdure over the surface of the ground? yet being more congenial to some families of plants than to others, its fertilizing effects are varied according to their peculiar structure and organization? Not from oxygenation, as has been supposed; for however necessary oxygen may be to animals, it is rejected by vegetables, as excrementitious.

Since writing the above, I have the satisfaction to find, from the experiments of Mr. H. Smith, near Sittingbourn in Kent, that the fertilizing effects of gypsum, though in a maritime county, seem not to be inferior to those which have long been experienced in the United States. 1. That he has employed it with advantage in calcareous, sandy, loamy, and even in stiff soils, previously ameliorated with chalk. As these form the constituent principles of almost every soil, his experience seems to correspond with that of Mr. Binns. 2. That it increased his crops of clover and lucerne at least threefold, and proved very beneficial to leguminous plants.

The result, therefore, tends to confirm my idea, that gypsum may be introduced into English culture, even in countries bordering on the sea, with a better prospect of success than has been generally imagined.

On the Parts of Trees primarily impaired by Age. In a Letter from T. A. KNIGHT, *Esq. F. R. S. to the Rt. Hon. Sir* JOSEPH BANKS, *Bart. K. B. P. R. S.*

From the PHILOSOPHICAL TRANSACTIONS of the ROYAL SOCIETY of LONDON.

IN the first communication I had the honour to address to you, (it was in the year 1795), I stated the result of many experiments on grafted trees, from which I inferred that each variety can be propagated with success, during a limited period only; and that the graft, or other detached part of an old tree, or old variety, can never form that, which can with propriety be called a young tree.

I have subsequently endeavoured to ascertain which, amongst the various organs that compose a tree, first fails to execute its office, and thus tends to bring on the incurable debility of old age; and the result of the experiments appears sufficiently interesting, to induce me to communicate an account of them to you.

Whatever difference exists between the functions of animal and vegetable life, there is a very obvious analogy between some of the organs of plants, and those of animals; and it does not appear very improbable, that the correspondent organ, in each, may first fail to execute its office; and satisfactory evidence of the imperfect action of any particular organ can much more easily be obtained in the vegetable, than in the animal world. For a tree may be composed, by the art of the grafter, of the detached parts of many others; and the defective, or efficient, operation, of each organ, may thus be observed with the greatest accuracy. But such observations cannot be made upon animals; because the operations necessary cannot be performed; and therefore, though there would be much danger of error in incautiously transferring the phenomena of one class of organised beings to another, I conceive that experiments on plants may be, in some cases, useful to the investigator of the animal economy. They may direct him in his pursuits, and possibly facilitate his enquiries into the immediate causes of the decay of animal strength and life; and on a subject of so much importance to mankind, no source of information should remain unexplored, and no lights, however feeble, be disregarded.

Naturalists, both of ancient and modern times, have considered the structure of plants, as an inversion of that of animals, and have compared the roots to the intestines, and the leaves to the lungs, of animals; and the analogy between the vegetable sap, and animal blood, is very close and obvious. The experiments also, of which I have at different periods communicated accounts to you, supported by the facts previously ascertained by other naturalists, scarcely leave any reasonable grounds of doubt, that the sap of trees circulates, as far as is apparently necessary to, or consistent with, their state of existence and growth.

The roots of trees, particularly those in coppices, which are felled at stated periods, continue so long to produce, and feed, a succession of branches, that no experiments were wanted to satisfy me, that it is not any defective action of the root which occasions the debility and diseases of old varieties of the apple and pear tree; and indeed experience every where shows, that a young seedling stock does not give the character of youth to the inserted bud or graft. I, however, procured plants from cuttings of some very old varieties of the apple, which readily emit roots; and these plants at the end of two years were grafted, about two inches above the ground, with a new and very luxuriant variety of the same species. These grafts grew very freely, and the roots themselves, at the end of four or five years, probably contained at least ten times as much alburnum, as they would have contained, had the trees remained ungrafted. The roots were also free from every appearance of disease, or defect.

Some crab-stocks were at the same time grafted with the golden pippin, in a soil where the wood of that variety rarely lived more than two years; and I again grafted the annual shoots of the golden pippin, with cuttings of a young and healthy crab-tree, so as to include a portion of the wood of the golden pippin, between the roots and branches of the native uncultivated species, or crab-tree; and in this situation it grew just as well as the wood of the stock and branches. Some branches also of the golden pippin trees, which I mentioned in my former communication of 1795, being much cankered, were cut off about a foot above the junction of the grafts to the stocks, and were regrafted with a new and healthy variety. Parts of the wood of the golden pippin, in which were many cankered spots, were thus placed between the newly-inserted grafts, and the stocks; and these parts have subsequently become perfectly free from disease, and the wounds, previously made by canker, have been wholly covered with new and healthy bark. These facts, therefore, satisfied me, that the debility and diseases of old varieties of fruit of this species, did not originate in any defective action of the bark or alburnum, either of the root, or of the stem and branches, and my attention was consequently directed to the leaf and succulent animal shoot.

A few crab-stocks were grafted with cuttings of the golden pippin, in a situation and soil, where I had previously ascertained that the wood of the golden pippin rarely remained in health at the end of a second year; and, as soon as the annual shoots had acquired sufficient growth and firmness, numerous buds of a new and luxuriant variety of apple, which had recently sprung from seed, were inserted in them. During the succeeding winter, the natural buds of the golden pippin branches were destroyed, and those inserted suffered alone to remain; and as soon as the leaves of these had unfolded, and entered on their office, every symptom of debility and disease disappeared in the bark and wood of the golden pippin; and each continued to perform its office, just as well as the wood and bark of the young seedling stocks could have done under similar circumstances. I made nearly the same experiments on the pear tree, and with the same result.

I have endeavoured, in several former communications, to prove that the sap of plants circulates through their leaves, as the blood of animals circulates through their lungs; and I have not subsequently found any facts, in the writings of other naturalists, or in my own experiments, which militate against this conclusion. I have also observed, that grafted trees, of old and debilitated varieties of fruit, became most diseased in rich soils, and when grafted on stocks of the most vigorous growth; which has induced me to suspect, that in such cases more food is collected, and carried up into the plant, than its leaves can prepare and assimilate, and that the matter thus collected, which would have promoted the health and growth in a vigorous variety, accumulates, and generates disease in the extremities of the branches and annual shoots, whilst the lower part of the trunk and roots remain, generally, free from any apparent disease. I am, therefore, much disposed to attribute the diseases and debility of old age in trees, to an inability to produce leaves, which can efficiently execute their natural office; and to some consequent imperfection in the circulating fluid. It is true that the leaves are annually reproduced, and therefore annually new: but there is, I conceive, a very essential difference between the new leaves of an old, and of a young variety: and in support of this opinion, I shall observe, that the external character of the leaf of the same variety at two, and at twenty years old, is very dissimilar; and it therefore appears not improbable, that further changes will have taken place at the end of two centuries *.

If these opinions be well founded, and the leaves of trees be analogous to the lungs of animals, is it very improbable that the natural debility of old age of trees and of animals, may originate from a similar source?—This is a question, upon which I am not by any means pre-

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* The leaf of a seedling apple or pear-tree, when the plant is very young, is generally almost wholly free from the pubescence or down, which subsequently appears on its under surface; and which BONNET and M. MIRBEL, have supposed to increase its surface and powers. But I feel little disposed to adopt this hypothesis, having observed that the leaves of some new varieties of the apple, which have sprung from seeds of the Siberian crab, have both surfaces nearly equally smooth; and that these varieties grow faster, and bear heavier crops of very rich fruit, than any others, without being exhausted or injured.

pared to give an opinion: but I believe it will very generally be admitted, that the human subject is best formed for long life, when the chest is best formed to permit the lungs to move with most freedom. I have also long and attentively observed amongst our domesticated animals, that those individuals longest retain their health and strength, and best bear excessive labour and insufficient food, in which the chest is most deep and capacious, proportionately to the length of current the circulating fluid has to run; and the same remark will, I believe, be generally found applicable to the human species.

Observations on the Subjects of Roads and Carriages.

By Mr. HORNBLOWER.

From the REPORTS of the HOUSE of COMMONS.

I FEEL myself under particular obligation for the favour done me by your presentation of the Report of your Honourable Committee, and for the honourable mention of my hasty letter on the subject it contains.

Being engaged on a temporary absence from the kingdom at that time, I could not enter so fully into the subject as its importance demanded; and hoping it will not be irregular at this advanced state of the business to add a thought or two, I beg leave to mention a few particulars which have occurred on reading the Reports.

It is scarce possible for men exercised in so varied a life to be entirely in one mind about it; but it seems that there are points in which we all agree, namely, that our roads are not what they may be; and that the time which has elapsed, has afforded an ample specimen of the competency of the present regimen to make them better.

I think there can hardly be any difference among practical men, as to the form which ought to be given to the surface of a road, so as to preserve its condition by suitable materials suitably applied through all the varied accidents and circumstances it is exposed unto.

It is absolutely necessary that such a figure should be given to it, that the wet should be discharged as quickly as possible. But while some gentlemen contend for a convex form transversely, as being the best, if not the only means of obtaining that end, they must have forgotten that the impressions made by the wheels are for ever longitudinal; and that whatever be the adventitious position of the road, the water can flow only in the direction of the channels made by the carriage-wheels; and that on a convex road, the line of which happens to be horizontal, the rain which falls on it can be got off by evaporation and absorption only, and that in a humid atmosphere the latter will be greatest.

Next, that a convex road and cylindrical vertical wheels are absolutely incompatible, though not so much as when the wheels are conical, unless the largest diameters were allowed to run outwards, or with the smallest diameter next the body of the carriage, which ought to be the case *upon all convex roads.*

But to get rid of the rains on the road in the most effectual manner, it should be so laid out, either by nature or art, as to have a current or currents from one end to the other, in other respects to be kept as flat as possible; and where the surface (lineally) is by nature on a dead level, it may be raised or sunk, or both, at certain places, so as to obtain a current for the rain along the channels formed by the wheels which may ultimately run off into the ditches. I have seen that a tenth of an inch in a foot will afford a very good current for channels of a street, and the same, or at most one-eighth, will be ample allowance for currents on a public road.

We are not to draw inferences in favour of a convex road, by the practice which has obtained in forming the carriage way of a street. There are no channels in a street formed by the passage of wheels upon it; but the materials or stones preserving their form, will always keep an infinitude of channelets (if I may use the expression) by which the rain will run off in all directions; and had it not been for this circumstance no apology could be offered for such a violation of common sense, as the formation of a convex road for wheel-carriages.

On the subject of wheels, I observe a similar difference prevail as on the formation of a road; but I do not apprehend that there is sufficient latitude or variety in roads to allow *any difference at all*, though the particular circumstances of some individuals may seem to demand such a consideration; but except the accumulation of inertia, rolling surfaces cannot be objected to in bringing roads into good condition, and preserving them in the best repair.

It has been observed, that cylindric wheels and rollers, such as Mr. Sharpe's, will collect the mud on their surfaces. But that need not be any hindrance, were it not for those preposterous heads of nails deemed so expedient for fastening the tire; though it would be no difficult matter to shew that they are of less importance in that respect than well formed heads in countersunk holes, which preserve a smooth surface, and would admit a piece of iron to be laid on the sole of the wheel, to cast off whatever mud or clay may adhere to it in its operation on the road. If there is any difference in this respect between the conical and cylindric wheels, it must originate in the difference of their form; and we all know the destructive difference there is between them, as has been so clearly demonstrated in the experiments shewn to the Committee. But sure the preservation of the roads and so trifling an accident (which may be removed by so trifling an expedient) ought not to stand in competition.

I see nothing in the Reports to shake my confidence in the method I have for many years insisted on for the repairs of *bye roads*; namely, broad-wheels, and light loads gradually increasing until old prejudices are done away, by which a whole parish may be convinced that in the worst of their bye ways nothing else would be wanting but a sound bottom. I confess I have often had my patience put to the test, in opposing the discordant arguments of some of the all-knowing sons of Ceres, on the subject of conducting a cart or waggon along a soft road, purely on the datum, That a narrow wheel meets less resistance than a broad one. But, thanks to superior acquaintance with experimental fact, that broad wheels operate to the utter extermination of the grievance so much to be deplored, while the constant application of narrow ones must, in the very nature of their action, increase it.

Respecting the use of one-horse carts, I have not had opportunity of practical information, but there seems to be material objections to the introduction of such a practice in general. No doubt but those who have been initiated in such a practice would find it irksome to adopt the use of four-wheeled carriages. But this must be admitted on all hands; that a carriage on two wheels will be continually varying the load on the horse's back as often as he has to ascend or descend a hilly ground. Secondly, in a country where such a practice has not already obtained, fatal accidents may be expected, by so many carriages being left to the management of one driver. This has been already anticipated, and prohibited by the Legislature.

Railways, I observe, are a part of the desiderata of this important business; and next to the inordinate expense attending the execution, there is one circumstance that strongly militates against the design, and that is, a complete revolution in the habits and customs of travelling from one place to another. Waggoners must undergo fresh discipline, coachmen must be content to form a cavalcade, and our saddle-horses must be trained to the gig (if such ways are to be formed according to the present practice). Railways have been in use in this kingdom time out of mind, and they were usually formed of scantlings of good sound oak, laid on sills or sleepers of the same timber, and pinned together with the same stuff. But it was not until the Proprietors of Colebrook-Dale Ironworks, a very respectable and opulent Company, determined to cover these oak rails with cast-iron, not altogether as a necessary expedient of improvement, but in part as a well-digested measure of economy in support of their trade.

From some adventitious circumstances (which I need not take time to relate) the price of pigs became very low, and their works being of great extent, in order to keep the furnaces on, they thought it would be the best means of stocking their pigs to lay it on the wooden railways, as it would help to pay the interest by reducing the repairs of the rails, and if iron should take any sudden rise, there was nothing to do but to take them up, and send them away as pigs.

But these scantlings of iron (as I may call them) were not as those which are now laid in some places; they were about five feet long, four inches broad, and one inch and quarter thick, with three holes, by which they were fastened to the rails, and very complete it was both in design and execution. Hence it was not difficult if two persons on horseback should meet on this road, for either to turn his horse out of the road, which on the railways now introduced would be attended with some serious doubt as to the consequences. But it would be impossible on the best railways, to afford that facility of travelling which we now enjoy on a spacious well managed road; and in my opinion would prove of greater detriment than all the obstacles we have to deplore in the present uncomfortable state of the roads. Railways may do very well as a substitute for canal navigation, but even then they ought not to intersect any of our public roads. I speak this from experience. And as to the introduction of railways in Sweden, it must be after they have adopted our conical broad wheel waggons, and narrow wheeled stage-coaches, and, by some unaccountable discovery, met with a trade which was never expected, so as to spoil some of the best roads in Europe. No, in the present state of things, they are satisfied with the advantages they possess, and there is no probability of a change.

The object of compelling different tracks is a very salutary measure. We may as well enact that all carriages shall follow one another, as insist that all wheels shall have the same lateral distance. No, let the distance

tance vary, and it will be impossible in that instance to contribute so much to the destruction of the roads. It would also be advisable, that as a road approaches any populous town, to extend its breadth, in order to amplify its access by the increasing numbers coming in congress from so many directions.

On the line of traction I observe a difference of opinion; and it must be that the honourable Member of your Committee, who has so consistently defined the use and application of wheels and springs, &c. has overlooked the nature of that force by which a loaded carriage is drawn along. In the case of an empty carriage, or any thing making but small resistance, the point is not the same as when a great load is to be overcome.

A team of horses passing on any of our summer roads, may have their action defined, as only leaning their bodies forward in that uniform pleasant manner we may often have had opportunity to observe; and the consequence will be, in drawing a conclusion from thence, that the carriage and load together must be much lighter than we imagine. But the fact is, that where a team of horses is thus engaged on an even road, they have little else to do than to overcome the friction of the axles and boxes; but on a road where hollows are suffered to abound through ignorance or neglect, you will see that the mere weight of the horses are not competent to the task, but that it is by muscular exertion, in unison with the general construction of the animal, that the load is overcome; but there needs no such action for the animal to lean forward. Let us consider the exertion of a horse to overcome a load which he is but barely able to move. Observe how he brings his body toward the ground, that he may have all the advantage possible, by the contraction and extension (alternately) of his hinder legs, to oppose the resistance. Now, if we are to account for his force being superior to the load, by merely leaning his body forward, it will not be in our power even to conjecture for what purpose those muscles are brought into action. The cause and effect are very different to that of drawing any thing along an even plane, by a weight descending from a pulley, which has been the general way of ascertaining the force required to overcome an obstacle placed before a loaded carriage, (and it is true that the force may thus be appreciated;) but it will ever be found to exceed all that a horse can exert by the harness lying in an horizontal line; added, that the construction of the animal at the shoulders, which is destined to re-action, does most imperiously forbid horizontal traces, and indicates in the most impressive manner that the line or traces should form nearly a right angle with the collar, as has been very clearly set forth in an experimental manner in the Report of the Honourable Committee.

It is a circumstance rather of individual interest, but as it has been noticed in the Report, I mean the mode of connecting wheels and axles, I cannot help adding an observation or two, particularly as the subject has not received all the attention it deserves.

There are but two modes of doing this, either by *fixing the axle*, or fixing *the wheels on* the axle.

For the sake of conformity to what custom and habit have sanctioned in point of elegance in carriages constructed for personal ease and convenience, something may be said in recommendation of the former practice, particularly as it affords an unrestrained latitude to the obliquity of the wheels; but without that, not one solitary argument can be adduced in its favour, for every thing else is against it, but especially on convex roads. Two cases present to prove it. First, when a carriage is drawn along out of the middle line of the road, the friction added to the under part of the hinder box, and the upper part of the outer box in the lowest wheel, and a similar increase of friction only on a change of parts on the contrary wheel, is beyond credibility. Secondly, that the natural and uniform friction is continually increasing as the boxes are continually running, for we are to estimate the space passed over by the rubbing surfaces as the diameters of the boxes, *not as the axles;* added, that there is great abridgment of strength in the framing of the wheel by the excavation of the nave or stock for the admission of the boxes, while the revolving axle has all the importance that can attach to strength, steadiness, solidity, and security; and if any changes take place in the course of time as to friction, it is that it will lessen as the bearing surface of the axle lessens likewise; added, that such a mode of applying wheels has the least friction possible.

I begun a set of experiments on this matter, on a large scale, so long as five or six years ago, which on account of some adverse circumstances was laid aside; but I do intend to resume it in a little time.

Chemical Examination of Woad and Indigo.

By Mr. CHEVREUL.

(Concluded from Page 192.)

III. *Examination of the Cake left by the expressed Woad.*

(a) THE woody remains of woad that has been pressed, which were still mixed with green fecula, were divided into two portions. The first yielded ashes, which were treated with water ; a large proportion of carbonate of potash was dissolved, and also some sulphate, muriate and phosphate of potash. These salts were recognised by the common methods.

The residuum of these ashes that was not dissolved by water, was soluble with effervescence in muriatic acid, except a small quantity of silica and charcoal that escaped combustion. The muriatic solution being evaporated to dryness, and then treated with alcohol, this solvent took up the muriates of lime, of magnesia, and of iron.

The remainder that did not dissolve in alcohol was treated with nitric acid. The solution contained phosphate of lime, manganese which was probably combined with phosphoric acid, and a little iron. The presence of manganese was indicated by prussiate of potash, a white precipitate was obtained, which was rather blueish on account of the iron that it contained. The small quantity of these products did not permit their being examined as to their containing phosphate of magnesia.

(b) The second portion of the cake was treated with boiling alcohol, which took up wax, a small quantity of indigo, and a red matter of which hereafter, green resin, and nitrate of potash. It is this last-mentioned salt that yields the greatest part of the alkali that is produced by the combustion of woad. The leaves of this plant contain such a large proportion of this salt, that it is only necessary to ignite them, to see the nitre burn away with the charcoal as it is formed. It is probable that the phosphate of potash obtained by the above-mentioned incineration, came from the decomposition of some earthy or metallic phosphate.

(e) The part that had been exhausted (b) by alcohol, was treated with dilute muriatic acid, in order to discover if it contained any oxalate of lime; but on saturating the excess of acid by ammonia, the granular precipitate which adheres to the sides of the vessels, and characterises oxalate of lime, was not obtained. The muriatic solution, besides other things, contained a good deal of lime in solution, which came from the malate. There is no doubt but that the carbonate of lime found in the ashes of woad is produced by the decomposition of that salt.

The woody fibres which had been washed with muriatic acid, were tinged in some places of a fine blue, by reason of the indigo that was combined with them. This wood being incinerated yielded white ashes, formed for the most part of silica.

Recapitulation of the Analysis of Woad.

I. *The Juice of Woad yielded,*

Indigo ad minimum, which was obtained by oxygenisement.

Vegeto-animal matter	by heat.
Sulphur	ditto.

Scented

Scented oil	by heat.
Ammonia	ditto.
Acetic acid	by heat and sulphuric acid.
Prussic acid	ditto.
Green matter	by alcohol.
Yellow extractive matter	ditto.
Nitrate of potash	ditto.
Muriate of ammonia	ditto.
Acetate of potash	ditto.
Muriate of potash	ditto.
Acetic acid	ditto.
Gum	by water.
Yellow extractive matter	ditto.
Acidulous malate of lime	ditto.
Sulphate of lime	ditto.
Citrate of lime and magnesia ?	

II. *The green Fecula yielded,*

Green resin	by alcohol.
Wax	ditto.
Indigo	ditto.
Vegeto-animal matter.	
Woody fibres.	

III. *The expressed Cake yielded,*

Woody fibres.
Green resin.
Wax.
Indigo.
Nitre.
Red matter.
Salts.

Examination of Indigo.

§ I.

The stalks of indigo that were analysed were at most 20 days old, the largest were 6 inches long, and the smallest 3 inches. The same method of examination was followed as for woad.

The juice of indigo contained indigo ad minimum; vegeto-animal matter, which presented the same phenomena in coagulation as that of woad; green matter; yellow extractive matter, of which it contains much less than the woad does, so that alcohol takes up but very little when it is digested upon evaporated juice of indigo; mucilage, a calcareous salt which was probably malate of lime; and alkaline salts.

The juice of indigo when quite fresh is not acid, but at the end of 24 hours, when the indigo has precipitated from it, it reddens litmus by reason of the acetic acid that seems to be formed.

The green fecula of indigo yielded indigo, wax, green resin, animal matter, and a peculiar red matter.

§ II.

The examinations here related are very insufficient to answer all the questions that might be asked respecting the culture of indigo-yielding plants in our climate; nevertheless a few reflexions on that subject may be hazarded. If it was desired to cultivate either woad or the proper indigo plant for the extraction of indigo; the preference should be given to the latter, as 10 grammes of this plant certainly yielded more indigo than 300 grammes of woad; the comparative quantity of colouring matter is not however rigorously determined, beause it is only by experiments made on a large scale, hat any decisive result can be obtained.

In the present circumstances, it would be very ineresting to discover the precise proportion in which inigo is found in the indigo plant, cultivated in France, in that of the colonies. It would also be interesting make experiments upon indigo plants of different ges, in order to discover if the time when it is comonly cut, is that when this plant would yield the eatest possible quantity of colouring matter; for, from me experiments, it appears that indigo exists in the ant while it is yet very young, and that there comes a ne when this principle would disappear, as well as the een matter. These observations were made upon ad cut at different ages, and upon a stalk of Parisian digo that had lived through the winter. Moisture apared to contribute to the destruction of the indigo, at e same time that it favoured the formation of yellow tractive matter, at the expense doubtless of the green atter, and of the green resin, which almost totally dispeared. Dryness on the other hand appeared to prerve the indigo, by causing it to pass to the maximum oxydisement.

It is most probable that the indigo is decomposed in e plant when it is ad minimum, for the leaves of woad hich contained indigo ad maximum in some places reserved the blue colour, while the indigo ad minimum ontained in the other parts of the same leaves was deomposed, when the footstalks of the leaves were imnersed in water. It is not however impossible but that ndigo ad maximum may be decomposed within the lant, by coming into contact with certain vegetable natters; for the experiments of Bergman, which have been repeated, prove that this decomposition takes place in indigo separated from the plant. It is probable that in this case, the indigo is reduced ad minimum, and that it is afterwards decomposed.

The indigo is contained in the leaf, and in the leaf-stalk; so that it may frequently be observed that on plucking a leaf from the stalk, the broken part of the footstalk turns blue after some time, especially if it be squeezed a little in order to press out the juice.

A physiological and anatomical examination of two plants taken from families so very natural as those of the cruciferous and leguminous plants, would be a proper task for an expert botanist; for if it be an object of curiosity to follow up the agreement between vegetables of the same family, it would be still more so to observe how far physiology and anatomy could agree with chemistry in vegetables of different families, which yield nearly the same products when analysed. The presence also of a substance so easily oxydised as indigo ad minimum in the green parts of a vegetable which frequently emit oxygen gas, would exhibit some interesting observations upon the functions of those parts.

§ III. *Red Matter contained in the Leaves of Robinia Altagana.*

The green feculas of robinia altagana having been treated with hot alcohol, in order to discover whether they contained any indigo, it was found that the filtered solutions deposited, on being cooled and left quiet for some time, a granular matter of a fine red colour, which possessed the following properties: It was not soluble in water, it was but slightly soluble in cold alcohol, bu was taken up by boiling alcohol; its solution was of

fin

fine yellow; it formed by spontaneous evaporation yellow circles on the sides of the capsule, and deposited a fine red matter on the bottom; to find whether this red matter was the same as the yellow matter, cold alcohol was poured into the capsule, which took up all the yellow colour and left a clear red, which on being treated with boiling alcohol tinged it yellow, and the solution had the same properties as the former one, so that it is probable that the yellow matter is only the red matter in a more finely divided state. Neither acids nor alkalies changed its colour in any very sensible degree. As only a few atoms of this substance were collected, no longer details can be given of its properties; but it must be observed, that slight traces of it were found in the fecules of woad and indigo.

It might be thought perhaps that this matter is analogous to that which tinges the leaves of the vine, cherry, &c. red or yellow, towards the end of autumn; but upon making comparative experiments, differences are observed. 1°. Cold alcohol dissolves the latter substance and becomes yellow, but the red colour appears on evaporating the solution. 2°. Boiling alcohol dissolves these colours still better, because they contain wax which defends them from the action of alcohol, when used cold; the solution is yellow, but becomes red upon evaporation, and if leaves partly yellow and partly red are operated upon (which is almost always the case), the wax precipitates and draws down along with it the yellow matter, while the red colour remains in the liquor. The red colour is soluble in water, and communicates its own colour to it. This solution is rendered yellowish green by alkalies, and afterwards red by the acids. Lastly, this red colour appears to be the most analogous to the colouring principle of the greatest part of red, rose-coloured, purple, and blue fruits and flowers; a principle which is naturally blue when it is pure, red when it is combined with an acid, and greenish yellow when it is combined with an alkali. As to the yellow colour, it is rendered reddish by alkalies, and yellow by acids. It therefore appears that the red matter of robinia which is not soluble in water, and the colour of which is not changed by acids or alkalies, ought not to be confounded with the red matter of the leaves of the cherry, &c. which is soluble in water, is rendered greenish yellow by alkalies, and red by the acids.

It remains to remark that the green fecula of some plants, and particularly of robinia altagana, appears to be combined with wax; for this last fecula yielded a large quantity of wax, although the leaves from which it was extracted had not that glaucous aspect which wax gives to those vegetable surfaces that it covers.

Note. Indigo plants cultivated in the open ground in a garden, situated near the hospital for invalids, by Mr. Brulley, yielded upon examination the same results as were obtained from the indigo plants from the Botanic garden.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CVII. SECOND SERIES. April 1811.

Specification of the Patent granted to JAMES FROST, *of Little Sutton-street, Clerkenwell, in the County of Middlesex, Brass Founder; and* JAMES FROST *the younger, of the same Place, his Son, also a Brass Founder; for an Improvement upon Cocks, or an improved Lock-cock.*

Dated June 22, 1810.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, We the said James Frost, and James Frost the younger, do hereby declare that the nature of our said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say: Instead of making the pin or revolving piece of our improved lock-cock solid throughout, excepting that part in which the aperture or channel, or perforation through which the liquor or fluid is intended to pass; we do make a cavity in the upper part of the said pin or revolving piece between the cross or handle or ring, or other termination made use of for moving the said pin or revolving piece and socket, into which the said pin or revolving piece is fitted by turning and grinding; and in the cavity so made, we do dispose and fix a lock having a bolt, and the other parts usually constituting such as operate by means of a bolt; and we do throw the said bolt backwards or forward by a motion at right angles to the axis of the said pin or revolving piece, by the action of a key or other similar instrument, in order that when the said bolt shall be protruded or shot out of its cell, in the manner of locking, part of the said bolt shall stand forward beyond the face of the said pin or revolving piece, and shall enter into a cavity in part of the motionless socket, into which the said pin or revolving piece is disposed or placed, and shall thereby render the said pin or revolving piece itself also motionless, and shall make it impracticable to turn or open the cock, until the bolt shall have been first shot back by means of its key; and we do so place or dispose of the said bolt in its own cavity or cell, and we do make the before described cavity or cell in the motionless socket, in such manner and positions with regard to each other, that the water-way or course through the cock shall be shut, whenever the said bolt is or shall be protruded in the manner of locking into the said motionless socket, and shall not be capable of being opened until the said bolt is or shall be unlocked or withdrawn. And farther, we do declare, that our said improvement upon cocks, by, through, or by means of which, we have distinguished such cocks by the denomination of improved lock-cocks, may be applied to cocks of various kinds and descriptions, and to the lower as well as, or instead of, to the upper part of the said pin or revolving piece, and the said bolt may also, when preferred, be made to shoot

hoot or lock into a fixed or motionless piece, proceeding from the vessel or receptacle in which any liquor or luid is to be guarded and secured by our said improvenent, as well as into a fixed or motionless piece, such is is hereinbefore described; and that the effect of the ast mentioned disposition and application of the bolt, vith regard to the said vessel or receptacle will be such, is not only to prevent the before-mentioned pin from revolving, with regard or in relation to the cock itself, but likewise to prevent the said cock whilst locked, from being unscrewed or drawn out of the before-mentioned vessel or receptacle. In witness whereof, &c.

Specification of the Patent granted to JOHANN GEORGE DEYERLEIN, *late of Long Acre, in the Parish of Saint Martin-in-the-Fields, in the County of Middlesex, but now of Cockspur-street, in the same Parish and County, Tool Maker; for a Machine, new Principle, or Method of making Bricks and Tiles, and also by Means thereof of Clay, Loam, or similar Materials to those commonly used in Potteries, to make all Sorts of Mouldings, Beads, Tubes, Gutters, Channels, or Cylinders to convey Water, Smoke, Steam, or any Fluid or soft Substance.* Dated March 22, 1810.

With two Plates.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I, the said Johann George Deyerlein, do hereby declare that the nature of my said invention, and the manner in which the same is to be performed, are particularly described and ascertained as follows; that is to say:

That the said machine, and the new principle or method which is manifested in the use and application thereof, are shewn in the drawings hereunto annexed, and in the explanations of the same herein contained; and the same doth consist in a box or receptacle into which the clay is to be put, and also a plug or plunger or forcing instrument, by means of which the said clay is forced onwards during working, so as to urge the same through one or more suitable openings or orifices which give the figure or form; and also certain mill-work, or other well known mechanism, for giving motion and effect to the said plug or plunger or forcing instrument, and also a fit carriage for receiving and conveying away the bricks or other products of the art; and if need be, another carriage for supporting and conveying the combined or united parts hereinbefore mentioned, during the time of working, or from place to place. And I do further declare, that all the said parts are capable of being varied as to their structure, form, dimensions, and putting together; and that the local situation, with the nature of the first mover or power to be applied, will indicate some of the said variations; but that all the said variations are such as are obviously deducible by a competent mechanical workman, from the said drawings and explanations hereunto and herein annexed and contained. And I do premise that the same letters of reference do indicate the same thing in each of the several drawings or figures.

Fig. 1, (Plate XIII.) is a side view of the machine supported on its carriage.

Fig. 2, is a side view of the carriage without the machinery, the one box open and the other shut.

Fig. 3, a bird's-eye view of the same.

Fig. 4, a front view with the carriage and machinery.

A, Figs. 1, 2, 3, and 4, is the carriage upon which the machine stands, and is supported during work, or conveyed from place to place.

B, and B *b*, are two cast iron or wood boxes, with a lid to open and shut like a common trunk.

C, the muzzle or front of the above boxes, which is screwed to the box by a flanch, and having suitable openings or orifices therein.

D, the frame which supports the machinery.

E, Fig. 4, a horizontal spindle, on which a fly with an endless screw is fixed.

F, Figs. 1 and 4, a vertical spindle, on the top of which is fixed a bevel cogg-wheel to receive the endless screw on the horizontal spindle E; and to the bottom of this spindle is fixed part of a cogg-wheel which falls into the rack work, which is seen in Fig. 5.

G, a bolt or lever on the lid of the boxes B, in order to open and shut the same.

Fig. 5, H H H H, a piston or plunger with the rack work, the ends of which fits nearly into the boxes B B.

I, part of a cogg-wheel which communicates with the rack-work on the piston H, and with every revolution of the spindle F, moves the piston H, backwards and forwards. In this construction the pistons alternately work, but the machine may be made with only one box, with one piston to work therein.

Fig. 6, a frame, such as is used with a common bow saw, in which is fixed a thin piece of plate, steel, or small pieces of wire or cat-gutts. I call this tool or instrument a separator.

Fig. 7, a side view of a wheel-barrow, which receives the bars of clay when pressed through the muzzles or front pieces C, in Figs. 1, 2, 3, and 4.

Fig. 8, a bird'-eye view of the above wheel-barrow.

L, Fig. 7, two iron or wood railings, one on each side of the wheel-barrow, to support the rollers 1, 2, 3, 4, and 5, of which only part is seen in the drawings, and over which rollers the bandages 6, 7, 8, 9, 10, 11, and 12, as seen in Fig. 8, are wound in order to receive the bars of clay when pressed through the holes in the front piece C; the frame L must also be made at right angles to the bandages at the end *a*; the black line at *b* is a saw cut in each rail, the same at *c*, *d*, and *e*. This saw cut must also be perfectly at right angles to the above bandage.

f f, Figs. 7 and 8, are hooks on each side of the barrow, and *g g*, Figs. 1, 2, 3, and 4, are pins on each side of the box, muzzle, or mouth-piece, in order to connect the wheel-barrow to the other machinery.

I now proceed to describe the process of brick-making with the above machinery.

The loom or clay, if the quality suits, may be taken immediately from the earth, and if mixed or tempered, should not be made so wet as in the usual manner; and it is necessary to have two or more wheel-barrows similar to the one described in Figs. 7 and 8, and a barrow being hooked to each end of the machine by the pins *g*, on the muzzle or mouth-piece, the machine is ready for its operation. I will now suppose the greater part of the piston and rackwork H, Fig. 5, to be contained in the box on the left hand B *b*, which then of course must be empty or contain no clay, and that box B on the right hand is filled with loam or clay; now the machinery is set to work, and the piston H is driven out of the empty box B *b*, into the opposite box B, the contents of which are by this means pressed through the seven orifices of the mouth-piece C, and received by the bandage on the wheel-barrow, Figs. 7 and 8; whilst this operation in the right hand box B, is going on, the left hand box B *b*, is filled by an attendant, as the piston makes room for it; now when the piston arrives a little beyond the hinge of the cover of the right hand box B, this box may be opened, and the left hand box B *b*, being by that time filled, must be shut, and nearly at the same time the motion of the machine will be changed, as is seen by the segment of the wheel I, in Fig. 5, and the same operation will commence in the opposite box B *b*. In this state it is evident that the greater part of the matter which was contained in the box B, will be now pressed through the seven or more or fewer oblong holes in the muzzles or mouth-pieces C, and will lay in the form of a flat bar on the bandage of the barrow, Fig. 7; and then the person who attends that side of the machine must take the separator, Fig. 6, and carefully cut down the right-angled edge or leading slit at *a*, which will separate the bars on the barrow from the machine, and then make an incision and cut down at *b*, *c*, *d*; and, at *e*, the superfluous matter must be cut off.

From the above description, it is evident that the seven bars which were pressed through the mouth-pieces C, and laid on the separate bandages on the barrow, Figs. 7 and 8, will have been cut into four pieces each (or any other number according to the dimensions), and will have by this means obtained the breadth, thickness, and length of a brick, so that by every home and out stroke of this machine, fifty-six bricks will be finished; or if the power of the first mover is increased either by additional men or otherwise, the barrow may be made as long again, and the machine be increased to double the size; by which means about four times the number of bricks above mentioned will be produced in about the same time, and so in proportion to the first mover, the product of the machine will be more or less.

The making of tiles is effected by unscrewing the mouth-piece C, from the boxes B *b* and B, and fixing to it such an one as is represented by a front view in Fig. 9, in which *h* is a slide that lifts up and down by the lever *i*; now if the lever *i* be pushed down by the hand, or a communication be made with the machinery, the slide *h* will be pressed home to its shoulders at *k*, and a flat hole will be formed, through which may be made flat tiles, or such as are used for flooring; but to make tiles for covering houses, the lever *i* must be lifted up and pushed down again, whenever it is required to make that projection which holds the tiles on the lathing, and this may be done by a communication with the first mover, or by an attendant.

Fig. 10, is a front view of a muzzle or mouth-piece, to be also screwed on the above boxes, B *b*, and B, for making mouldings to ornament buildings, and channels to convey water; and it is plain that whatever shape the hole is made into, the same form will be obtained by the clay pressed through it, which is received on bandages over rollers to the length required, and then cut off even at each end by the separator, as described in brick-making.

Tubes and pipes are made in round or square boxes, or receptacles of wood or cast iron. The piston should nearly fit tight, and be supported or side steadied when lifted above the round or square box or receptacle, in order that the same may be filled, as seen in Fig. 11, which is a view of a cast-iron receptacle of a cylindri[illegible]

for[illegible]

Fig. 6.

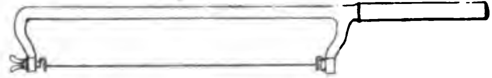


Fig. 5.

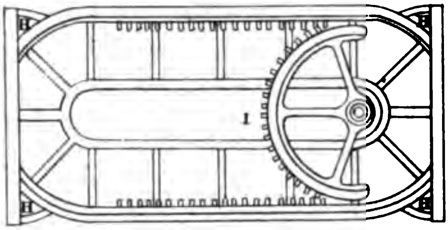
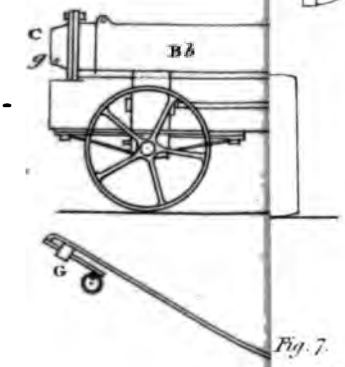
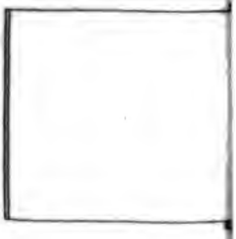


Fig. 1.





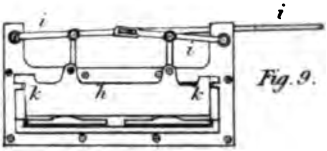


Fig. 9.

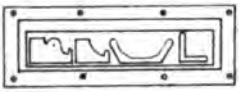


Fig. 10.

Fig. 7.

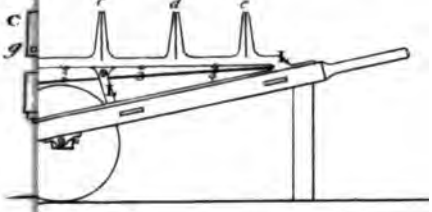
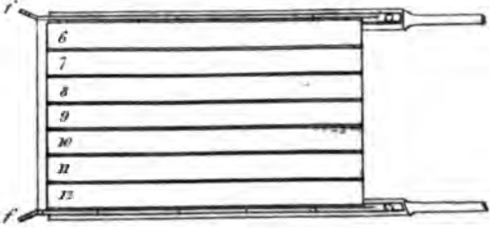


Fig. 8.



Specification of the Patent granted to THOMAS POTTS, *of Hackney, in the County of Middlesex, Gentleman; for a new Process of freeing tarred Rope from the Tar, and rendering it fit for the Use of the Manufacturer.*

Dated February 4, 1809.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Thomas Potts do hereby declare that my said invention is described and ascertained in manner following; that is to say: My process for freeing tarred rope from the tar, may be conducted in three different ways: first, by means of sulphate of alumine (common allum); second, by sulphate of alumine and fullers earth; and third, by fullers-earth.

First, by sulphate of alumine: let the rope be cut in proper lengths, which must be determined by the length of staple required, and the lengths opened into yarns; when opened, let them be put into a proper vessel for boiling; suppose the quantity to be only one hundred weight, cover it with water and add five pounds of sulphate of alumine, bring the rope and liquor to a boil, and let the whole continue to boil for one hour; take the material out of the boiling vessel and put it into a pair of fulling stocks, or any other machine capable of beating and turning it, for every thing performed by machinery is generally preferable to manual labour. Work and wash the pieces of rope for one hour, take them out of the fulling stocks or other machine and return them into the boiling vessel, cover them again with water, and into the water put from five to ten pounds of carbonate of lime (whiting is best), stir the whole well and bring to a boil, and continue to boil for half an hour; take the pieces of rope out of the boiling vessel, and again return them into the fulling stocks or other machine, and work and wash them quite clean, when they will be in a fit state to be bleached, either on the grass or by the oxymuriatic acid.

Second, by sulphate of alumine and fullers earth: one hundred weight of the rope being cut and opened as directed in the first process, let it be put into the boiling vessel, and when covered with water, let the same quantity of sulphate of alumine be added as directed by the first process, bring the whole to a boil and continue to boil for one hour; take out the material or pieces of rope, lay them as before directed in the fulling stocks or other machine, and work and wash it or them for one hour, return it or them into the boiling vessel, cover with water, add from five to ten pounds of carbonate of lime (whiting is best) and stir well; let the whole boil and continue to boil for half an hour, take the material or pieces of rope out of the boiling vessel, put it or them into the fulling stocks or other machine, work and wash for a quarter of an hour, plug the holes in the stocks or other machine, and add from twenty-eight to fifty-six pounds of fullers earth, or any clay equally free from sand, and containing an equal portion of alumine previously reduced or converted to a semi-fluid state, or to the substance of pap by means of water; let on no more water than will keep it or them moist, and let it or them work freely; work the whole for half an hour, let on a sufficiency of water and wash quite clean; the produce of the rope will be in a fit state for bleaching, either on the grass or by the oxymuriatic acid.

Third,

Third, by fullers earth: one hundred weight of rope being cut and opened as directed in the first process, let it be put into a boiling vessel covered with water, brought to boil and continue to boil for one hour; take it out of the boiling vessel, plug the holes in the fulling stocks or other machine, and lay it in; pour on it fifty-six pounds of fullers earth previously reduced to a semi-fluid state, or converted into the substance of pap by means of water (or any thing equally free from sand, and containing an equal portion of alumine); let on no more water than will make it sufficiently moist, and work for one hour without any further washing, put it into the boiling vessel, cover it with water, bring it to a boil, and let it continue to boil for half an hour; take it out of the boiling vessel, lay it in the fulling stocks or other machine, and add from twenty-eight to fifty-six pounds of fullers earth, or any other clay equally free from sand, and containing an equal portion of alumine prepared as before directed; let on no more water than will make it sufficiently moist, work it for one hour, take out the plugs of the fulling stocks or other machine, and work and wash till perfectly clean, when it will be in a fit state for bleaching either on the grass or by the oxy-muriatic acid. When the boiling is performed by steam, which is most economical, the vessel will not need filling up because the condensation will be equal to the evaporation; but if boiled on the naked fire, water must be added to make up for that which evaporates.

In witness whereof, &c.

Specification of the Patent granted to HENRY STUBBS, *of Piccadilly, in the County of Middlesex, Blind-maker; for a new-invented grand imperial Aulacum, from three to eighteen or twenty Feet wide, without Seam, and to any Length or Colour, for decorating the most superb or useful Rooms, for such as Drapery, Curtains, and Fringes, Chairs, Sofas, Tables, and other Articles of Furniture; or finished on one side only, for ornamental Hangings, Borders, and any other Species of Decoration.*

Dated October 8, 1810.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Henry Stubbs do hereby describe and ascertain that my invention consists in embellishing the interior of superb mansions, principal rooms, or elegant apartments. The aucalum is manufactured from one to sixteen feet wide, more or less, as may be required, without seams, and to any figure or design. The texture surpasseth superfine cloth, and its beauty approaches near to that of velvet, consequently when hung on the walls and other places where hung, exhibits a lustre of grandeur and magnificence to the eye of the beholder. As it refers to the materials from which it is manufactured, it is produced by art and labour principally from fine linen and worsted cloth; these two articles are inseparably attached and firmly incorporated into each other chiefly by glue, and a small portion of colour, with some driers, of binding and adhesive qualities, of the two aforesaid articles; the most prominent and that which constitutes the fine face and beauty of the aucalum is a dyed, coloured, or white flock; this being prepared, I proceed with the fine linen and worsted cloth which answers for the back or ground of the aucalum; this fixed in a frame or otherwise suspended in length and breadth, either perpendicular, leaning, or horizontal, it then receives a considerable quantity of glue, together with a small portion of water colour; these two ingredients, warmed to a proper consistency of heat and laid on with a brush, or otherwise, at once form a flexible parchment; this operation of the brush gives lassitude to every thread; the cloth will then expand near three inches in every three feet; the frames must then be extended in all directions to the utmost extent that the worsted or linen will admit of; it is thus extended, and by means of heat dries, and is invariably fixed as to its dimensions; when thoroughly hard or dry a second process commences, the parchment undergoes some considerable friction from the pumice stone, all prominent threads and superfluous glue is cleansed off, and then what follows is a thin coat of colour, as near as possible to the colour of flock intended for the face of the aucalum; the whole piece of parchment being thinly covered, the flock is put into a sieve and dispersed over the whole piece, which still continues strained to a very high pitch so as to form its own drum, the aucalum is then dressed on the under side, and flock diffuses and regularly adheres to the composition until finished; nothing more is required to complete the aucalum but strong fires, which dry and take off all kind of effluvia.

In witness whereof, &c.

Specification of the Patent granted to RICHARD WOODMAN, *of Hammersmith, in the County of Middlesex, Boot and Shoe-maker; for a Method of manufacturing all Kinds of Boots, Shoes, and other Articles.*

Dated October 8, 1810.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Richard Woodman do hereby describe and ascertain that my method of manufacturing boots and shoes consists in closing or sewing the upper part of boots and shoes with hemp, in the usual way, or with wire made of iron, steel, brass, copper, tin, or any other metal. And also, that it likewise consists in connecting the sole and upper leathers with screws or staples, made of iron, steel, brass, copper, tin, or any other metal.

In witness whereof, &c.

Hints on the Improvement of Wheels and Axletrees, &c.

By JOHN BROWN, *late Millwright in Glasgow.*

From the REPORT of a COMMITTEE of the HOUSE of COMMONS on the Preservation of Roads and Highways.

HITHERTO I have not known any wheel or axletree makers, when advancing the diameter of wheels, extend the lengths of axletrees and naves of wheels in proportion to their height, which ought to be the case.

The mail-coaches, and other similar carriages, are so far improveable as to be made, with little additional expense or weight, to move with about one-sixth part of less exertion, and not to injure the roads one-third part of what they have hitherto done; also, to produce less jolting, and not so liable to overturn; besides, the wheels and carriages connected with them are neither so much strained, nor so liable to give way.

The suggested improvement will not produce any additional movements, and is, at the same time, on a very simple principle. It consists in advancing the wheels in height, extending their axletrees and naves in length, with a little alteration in the formation of their make.

To accomplish the above object, the wheels ought to be enlarged one foot in diameter; the fore wheels, four feet eight inches high; the hind wheels, five feet eight inches high; the spokes, perpendicular; and the rims, a flat surface of not less than three inches broad. The perpendicular wheels are not dished, and have no inclined forms.

First, High wheels are advantageous, in having a greater distance from their centre to their circumference, which produces a constant and equal aid of lever power, in forwarding and surmounting any obstacles. Secondly, they turn slower round in their advancing courses, and their oil or grease is not so soon expended. Thirdly, their rims form a flatter circle, which produces a larger application of the surface of their tire on the roads or ground which they traverse, which causes them not to sink, and prevents injury.

The utility of long axletrees is obvious; First, in proportion to their extended lengths, and in proportion to the height of the wheels which they govern, they produce less jolting, consequently, carry passengers or load smoother along. Secondly, the carriage is not so liable to overturn. Thirdly, they are not so injurious to the roads or ground they traverse. Fourthly, less power is required to move them, and therefore must be easier for the horses. Fifthly, they are not nearly so destructive to the wheels and carriage, harness, &c.

The benefit of naves being extended proportionably in their lengths, in conformity to the diameter or height of their wheels, is, that whatever be the condition of the roads they travel, they will produce a more steady and easy movement, and are of peculiar advantage in rough roads or in crossing declivities, as the boxes in the naves do not cause such forcible grips of lever power on the axles, and are less impeding to the draught; besides, the oil or grease in the axles or boxes is not so soon expended, and thereby effects less wear.

The axletrees ought to be finished in turning-laths, and of an equal thickness at each end where they enter the wheels; likewise, the boxes placed in the centres of the naves, exactly of the same width.

Coach axletrees have been hitherto used below their wooden beds. Placing them above, with proper iron hoops, one on each end, will afford reception to the suggested higher wheels, and continue the carriage as low as formerly.

In all cases, the fore and hind axles ought to be extended in exact proportion to the height of their respective wheels.

The aforesaid perpendicular wheels will produce two tracks three inches broad each, which are exactly equal to three of those hitherto used.

The perpendicular wheels, with the rims, the flat surface, and the axles, must be of an equal thickness where the wheels revolve, as inclined forms are not so agreeable to their government.

Every description of coaches, carts, and other carriages I have yet measured, are from four feet four inches to four feet six inches betwixt their tires and the tracks they make.

Three inch plank is the general thickness of wood used for making wheels; but when finished, the rims of mail-coach, &c. wheels are reduced to two inches broad; long coaches and carts, to two and one-fourth; and a few, to two and one-half. Making rims of wheels so narrow is prejudicial to the interest of the community at large, and ought to be prohibited by Government.

When wheels are advanced in their diameter, and the surface of their rims made broader, the iron ought to be proportionably thinner, so that it may not add to the weight of the wheel. The high wheels revolving slower in their forwarding, and being broader, the rim will last equally long as with a narrow thick rim upon a low wheel.

The common height of mail-coaches is eight feet, and are allowed to carry four inside passengers, besides guard, driver, and luggage. The height of long coaches is eight feet four inches, and are allowed to carry twelve inside passengers, and not unfrequently as many outsides. The following are some of the erroneous plans and injurious effects of the above carriages: First, the extreme narrowness of the surface of the tires of the wheels. Secondly, the fore and hind wheels running in the same track. Thirdly, their axles being too short for the height of the wheels and carriage. Fourthly, the centre of gravity of the hind axle, shifting farther than the fore, in overcoming obstacles, and being more deficient in length in proportion to the height of the wheels. Fifthly, the carriages measuring in height near double the wideness the wheels are extended from each other.

In short, in the whole structure of these carriages, science seems never to have been consulted; or, if consulted, to have given her advice entirely in favour of coach-makers, road-menders, and horse-jockies.

It would be of great advantage to many farmers, in particular situations, to have the axles of their carts made so long as to separate the rims of the wheels near nine feet, which is about double the usual length; the bodies of the carts widened in the same proportion, a little added to their lengths, and their sides made lower. But the two cart-shafts, instead of being at the extremity of the body of the cart, must be placed only at the usual distance, for the proper reception of the horse.

The suggested extension of the bodies of carts will require but little more weight of wood, while, at the same time, it is a great deal lighter for the horses, the load being lower and resting on a larger surface, which is of considerable advantage in hilly and marshy ground, and is peculiarly advantageous in carrying home harvest loads.

The utility of wide-bodied carts must be obvious to all who seriously consider them, as, besides possessing all the advantages peculiar to long axletrees, they are much easier loaded, requiring both less exertion in lifting, and skill in packing.

The wheels of all travelling carts, and a great part of those used by farmers, ought to be five feet in diameter, this height being not only preferable, but more suitable to the present improved breed of horses. In order that the bodies of the carts may be no higher than formerly, all the wooden beds which are placed on iron axletrees, and the wooden blocks which are placed above them, ought to be laid aside.

An iron axletree, when properly made, is sufficient, independent of any aid of wood. It ought to be made broader on the upper side at the draught-bolt bores, where the shafts of the cart rest on, to preserve the axle from sinking in the wood.

When a horse is properly yoked, the shafts should be level, running parallel with the middle of his body, so that the fore and hind ends of the shafts measure the distance from the ground, provided it be level, which may be tried by reversing the position the horse and cart are then standing in. If the foregoing rules be attended to, it will be found that wheels five feet in diameter, are not too high for the generality of horses now in use.

The common height of the greater part of cart-wheels at present used in Glasgow and its neighbourhood, is four feet six inches, and the distance between the rims of the two wheels, is from four feet four inches to four feet six, which nearly corresponds with the diameter of the wheels. This being the case, when the cart is partially raised by obstacles on the one side, the centre of gravity shifts exactly one-half of the height of the obstacle, and the part of the rim of the wheel then uppermost, shifts the whole height of the obstacle ; and, upon the same principle, the higher a load is, when one wheel either ascends or descends, the danger of oversetting is proportionably greater.

The carts generally employed for carrying cotton from Glasgow to the different mills in the country, are usually loaded with five large bags, which, owing to the narrowness of the carts, causes them to be placed in a very unfavourable position, by putting three above two.

Carriers' carts are also very deficient in wideness, which puts them to much inconvenience in packing large bales and boxes, and obliges them often to place smaller and lighter parcels under, to make the larger project over the wheels. To remedy which, one-third, at least, ought to be added to their width.

I have always been of opinion, that the length of a nave ought to be one-fourth of the diameter of the wheel in which it is placed; and that the length of the axletree ought, at least, to be so long as to cause the rims of the wheels to stand at a distance from each other, equal to the diameter of the wheel; but let it be understood, that making the axletree even longer than this, will be still more advantageous.

It may, perhaps, be asserted, that the aforesaid alterations will require wider roads and gates, for the admission of the carriages made on such a principle; and that, in time of snow, the wheels making four tracks, instead of two, will be an additional weight to the horses. This is granted, in part, but the numerous additional advantages to be derived from their adoption, will infinitely more than counterbalance any temporary inconvenience attending it.

Owing to the recent improvements in machinery, and of the application of power by means of steam-engines and water-wheels, axles and boxes of every description, can be turned as exact as clock-work, and at a very moderate expense.

A Detail of Experiments to ascertain the daily Quantity of Brown Muscovado Sugar necessary to fatten Sheep; to shew its Effects and Value when so applied; and to demonstrate what Substance or Substances, sufficiently cheap, might be mixed with it, so as to prevent its Application to common Uses, and yet render it not unpalatable nor pernicious to Animals which feed upon it.

By the Rev. Dr. CARTWRIGHT *.

From the COMMUNICATIONS to the BOARD OF AGRICULTURE.

NOT having had, for some months past, any particular business exclusively to occupy my attention, and conceiving that my spare time could not be more usefully employed, nor in any way more demonstrative of that respect and gratitude which I owe to a Society by whom I have been so repeatedly distinguished, I determined to devote the leisure, which I now had to command, to such pursuits as I thought might best accord with the wishes of the Board of Agriculture; and such as, at the same time, my limited power and opportunity might best enable me to prosecute. With this view I purchased a small flock of sheep, for the purpose of instituting a set of experiments to ascertain the facts enumerated in the title of this Memoir.

My flock, which consisted of fifteen two-shear southdown wethers, was purchased at Chichester market, August 24th, 1808. They were bred upon the downs by Mr. Deerling, of East Dean, had been folded through the he summer, and were in a common store state. Au-ust 27th they were weighed, and their respective eights were as follows:

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* This Memoir was rewarded with a piece of plate, having been sent in claim for Premium.

No. 1	100lb.	No. 6	92	No. 11	88
2	95	7	90	12	94
3	84	8	87	13	84
4	94	9	87	14	85
5	78	10	96	15	100
Total	451		452		451

Their average weight it will appear was 90¼lb. and as ey were purchased at 35*s.* *per* head, their price was ¾*d.* and a fraction *per* lb. live weight.

For the first week they were folded every evening, nd had half a pint of bran * and a quarter of a pint of ease each. They continued in the fold all night. The same feed was repeated in the morning; they were then turned out into a grass field. As soon as it was perceived that they were sufficiently habituated to dry food, which, it may be observed, was in the course of a week, they then had, in addition to the above stated quantity of bran and pease, an ounce each of sugar *per* day. Having familiarized them to the taste of sugar, it was my next object to try what different substances might be given, in addition to the sugar, which I conceived would not be injurious to them, which they would not reject, and which, at the same time, would spoil the sugar for all other purposes.

I thought it better to try the experiment with these different substances in this stage of the business, while the sheep had access to the grass field, rather than wait till they were kept upon artificial food altogether; because as they would have then no other food to fly to, hunger would compel them to eat that which might, perhaps, be exceedingly disagreeable, if not pernicious to them.

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* The bran was first given dry; but that being found inconvenient, from its getting up the sheeps' nostrils and teazing them, it was afterwards damped, so as just to prevent its being blown about by their breath.

The substances which I used for this purpose were linseed-oil, train-oil, palm-oil, oil of hartshorn, assafœtida, urine, antimony and charcoal; the greater part of which, it is well known to chemists, will prevent the sugar from being used in distillation, and all of them from being applied to common purposes. Add to these considerations, that none of them, charcoal perhaps excepted, can be separated from the sugar with which they may be mixed, but at an expense and trouble which would more than counterbalance the drawback.

The first substance which I tried was raw linseed-oil, in the proportion of one to thirty-two parts of sugar. That I might ascertain in what degree the smell or taste of it was repulsive, I mixed it, at first, with the sugar and food in one trough only, of which there were three. As the whole flock was suffered to have access equally to the three troughs, it might easily be seen how far the linseed-oil excited aversion or disgust. The linseed-oil was given to them, for the first time, September the seventh. I was greatly surprised (calculating upon the offensiveness of raw linseed-oil to the human palate) to find that the sheep fed at the three troughs indiscriminately; eating, with apparently the same appetite, the mixture which contained the linseed-oil, as those which had not been contaminated by such addition.

On the following day linseed-oil was mixed with the sugar in all the troughs, in the increased proportion of one to sixteen, which the sheep again devoured with the same appetite as before *.

Having completely satisfied myself that linseed-oil, in the proportion of one to sixteen parts of sugar, which is considerably more than sufficient to spoil the sugar for common purposes, was not unpalatable to my sheep, I next gave them train-oil in the same proportions, and with the same success. Indeed, from the particular avidity with which they devoured this mess, it is not unreasonable to suppose that the train-oil, so far from rendering the sugar less palatable to them, gave it a more agreeable zest and poignancy.

My next experiment was with assafœtida; which I gave in the proportion of one to four hundred and forty-eight parts of sugar. Part of the sheep began upon the mixture immediately on its being put into the troughs, and continued to eat of it, seemingly with the same relish, as of the preceding mixtures. The other part, taking the alarm, it may be supposed, at the smell of the assafœtida, hesitated for a few moments before they began to eat; and when they did begin, it was somewhat fastidiously. But during the whole time while I remained with them, which was till the troughs were about half empty, I did not perceive that any of them relinquished their food altogether. Had they been fasted an hour or two longer before this mixture had been given

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* Mr. Oliver, of Little Hampton, when his hay has been damaged by the weather, has mixed linseed oil with it, on putting it into the rick, in the small proportion of one quart to a load of hay, with good effect, sheep and cattle eating it very freely. This practice suggests a hint that deteriorated sugar might very usefully be mixed with hay in the like case.

given to them, their fastidiousness, as I then thought, would probably not have been discernible. And yet, on inspecting the troughs after the sheep had done eating, and had retired to lie down, it was found that they had not emptied them out so clean as usual, having left rather more than half a pint of food in the three troughs.

On the following day the assafœtida was repeated, but not till the sheep had been in the fold full three hours. This circumstance did not seem to have made any difference whatever, some of the sheep feeding heartily as before, and others with great indifference. On inspecting the troughs, when the sheep had done eating, there was found somewhat more food remaining than on the preceding day. For the present, therefore, I determined to suspend, if not drop, this experiment altogether; especially as it did not seem to be of sufficient importance to merit many trials; satisfying myself that if the wishes of the Board of Agriculture to obtain a drawback of the duty on sugar can be accomplished by no other more convenient substance than assafœtida being mixed with it, very few repetitions of the mixture would soon habituate cattle of every denomination to its use.

My next experiment was with urine; which was mixed with sugar in the proportion of one part urine to twenty-four parts of sugar; a much greater proportion, I should imagine, than could possibly be requisite to render sugar totally unfit for every domestic purpose.

But now an unforeseen obstacle arose to prevent my experiments from being carried on at the usual hour; for no sooner was the food put into the troughs, than it was taken possession of by a colony of bees from some of the neighbouring hives. They had, indeed, for two or three days before this appeared in small detachments; but these marauding parties, though evidently an annoyance, were not sufficiently masters of the field till this day (September the twelfth,) when they made a regular descent upon the troughs, in such force, and manœuvred so well, as completely to deter the sheep from approaching them. This untoward circumstance obliged me to reverse my mode of proceeding, and to feed the sheep in the evening. It was with much regret that I felt myself compelled to do this, as I could not now (the place where the sheep were folded being at a considerable distance from my lodgings*) so conveniently see them fed, and watch them myself, as I had hitherto done.

For the first evening I gave them sugar only in their food, not wishing to mix with it any alloy till they felt themselves quietly reinstated in possession of the troughs. The next evening the experiment with urine recommenced. Judging from the manner in which it was observed that the sheep fed, and the time that they were employed in feeding upon, and finishing this mixture, (which they did by licking out the troughs absolutely clean), there was certainly no reason to conclude that the urine had any influence in abating their appetites, or was in any degree offensive to them.

The experiment, next in succession, was with palm-oil; a substance which, it had been suggested, was very likely to answer the purpose which the Board of Agriculture has in view; and, as far as the sheep were concerned, the experiment fully justified the suggestion. They did not seem conscious that any variation had been made in their usual repast. The eagerness, indeed, with which they feasted upon it might imply that, according to their estimation, it rivalled in delicacy, and flavour, urine or train oil. It would have been singularly strange if the sheep, after eating such nauseous substances as linseed oil, train oil, and urine, without expressing the least dislike to them, had objected to a substance like this, which is considered by the natives of Guinea, where it is found, as neither unwholesome nor unpalatable, it making a considerable part of their daily food. It is eaten by them as we eat butter, which it much resembles in colour and consistence. It is much to be doubted, however, whether this substance alone (there being nothing either in its smell or taste which the human palate will in general revolt at) would prevent sugar from being applied to some at least, though certainly not all domestic purposes.

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* At Little Hampton, a watering place on the coast of Sussex.

It now occurred to me, for the first time, that the appearance of hesitation and fastidiousness which I noticed on the exhibition of assafœtida, and which I then attributed, in a certain degree, to the unconquerable offensiveness of that article, might have been occasioned by the annoyance which the sheep at that time experienced from the bees. That I might be completely satisfied on this head, I resumed the experiment, now that there was no danger from the intrusion or attack of these formidable invaders. Accordingly I gave to them assafœtida as before, in the proportion of one part assafœtida to two hundred parts of sugar. The event confirmed my suspicions, and turned out exactly as might have been predicted. The sheep, now under no apprehension of hostility from the bees, began upon their evening meal without hesitation, and concluded it without betraying the least symptom of fastidiousness or indifference. Indeed, they seemed to regale upon it,

> "As though increase of appetite did grow with that it fed on."

I have not, however, the temerity to affirm that they appeared to eat it quite so greedily, or with the same gusto as epicures, it is said, devour beef-steakes when assafœtida has been rubbed upon their plates; whether to provoke appetite, which without such a stimulus they are afraid would not be sufficiently voracious, or to give a higher relish to their repast, they possibly can explain; the beasts which I have treated with assafœtida, unluckily for the completion of this part of my narrative, cannot.

My next experiment was with *oleum animale*, or the empyreumatic oil of hartshorn; a substance uncommonly offensive to the smell; a sense which seems to influence animals of every kind in the choice or rejection of their food, as much as the sense of tasting. Indeed, until their sense of smelling has approved of what is offered to them, nothing but hunger, the most importunate, will prevail upon them to taste it. This circumstance made me apprehensive that there might be some difficulty in reconciling my flock to the repast which I had now prepared for them. I did not perceive, however, that the suffocating scent of the oil was in the least regarded by them, or that their sense of smelling gave the alarm to any other sense. I observed that two or three of the sheep, whether in consequence of the pungent smell of the oil or not, I am unable to say, occasionally blew forcibly through their nostrils. But, by whatever this might have been occasioned, it was evidently from irritation, not from disgust; as they completed their repast with equal expedition as before. The proportion in which the oil of hartshorn was given wa one to two hundred and twenty.

Besides the above substances I gave antimony, in th form of emetic-tartar, in the proportion of one to tw hundred and forty. This drug might certainly hav been given in much greater proportion without any sen sible effect upon the sheep, which, indeed, it was no intended to produce: my object being merely to mix i with the sugar, so as to render the the sugar sufficientl emetic to prevent its being used for domestic purposes; and also to add to the difficulties of freeing it from the extraneous substances with which I should propose to adulterate it to entitle the consumer to the drawback.

Having now satisfied myself that of the substances recommended for the purposes of rendering sugar unfit for common uses, and of which I have had the trial, there was none which sheep would reject when mixed with sugar in such proportions, as in the opinion of chemists, would answer the end proposed; I thought it might be satisfactory to the Board to know in what larger proportions some of the principal of them, namely, the oils, might be given, before the sheep would betray symptoms of disgust. Beginning in the same order as before, I first gave them linseed-oil in the proportion of one to eight, at the same time increasing the allowance of sugar to two ounces each *per* day. This allowance commenced on the nineteenth of September. Saturated as the sugar was with the linseed-oil, it appeared to be equally as palatable to the sheep as any thing which had yet been administered. Train-oil and palm-oil were then given in succession, in the same proportions, and with the same results.

Having continued this suberabundant quantity of the

oils

for some days, I was particularly attentive in re-
king the effect it might have on the bowels. I did
, however, perceive that the state of the bowels varied
n that in which they had been in for a fortnight be-
, namely, moderately relaxed; which is usually the
e when animals are in a thriving state.

eptember the twenty-fourth, the sheep were again
ghed. The following table will shew their former
ght, and what they have gained.

	August 27th.	September 24th.	Increase.
No. 1	100lb.	120lb.	20lb.
2	95	120	25
3	84	104	20
4	94	114	20
5	78	94	16
	451	552	101
6	92	110	18
7	90	104	14
8	87	110	23
9	87	102	15
10	96	114	18
	452	540	88
11	88	106	18
12	94	112	18
13	84	99	15
14	85	100	15
15	100	122	22
	451	539	88
Total	1354.	1631.	277.

From this table it will appear that, in the space of twenty-eight days the whole flock, upon the average, increased upwards of one-fifth of their original weight; and that two of them made, in the same space of time, the astonishing improvement in their weight of upwards of one-fourth!

The gentleman, who was so good as to purchase the sheep for me, on my asking him how long it would be, before he thought they would make themselves fat with grass only; told me not before Christmas. Another gentleman of equal experience was of opinion they would not be thoroughly fat before Candlemas. I do not mean to say that they are now as fat as these gentlemen would propose to make them; but even, in their opinion, a considerable part of them are in a marketable state of flesh, and probably in that state of flesh which would be nearly as profitable to the grazier as a fatter state, obtained at the expense of keeping them longer.

From September the twenty-fourth, till October the twenty-second, I increased their allowance of food to a quart of bran *per* day, one pint of pease, and three ounces of sugar, ringing changes at the same time with the different substances with which the sugar was debased. This I did with a view to discover, if possible, the particular substance which they most relished; but this was no easy task, as nothing seemed to come amiss to them. Indeed, they were now so eager to be fed that, as soon as they perceived the servant who fed them make his appearance in the field, they immediately ran to the pens, and on their being excluded till the food was properly disposed of for them in the troughs, their impatience to be admitted was such, that several of them repeatedly attempted to leap over the hurdles. Were

I, however, to hazard a conjecture to which they gave the preference, I should say it was train-oil; and yet I scarcely know why I should lean to this opinion, unless it be that after the train-oil had been mixed with the sugar for several successive days together, on its being accidentally omitted and the sugar given alone, (which happened at two different times) the sheep were observed to feed on those particular days with less avidity, and to leave part of their food remaining in the troughs. Conceiving it, however, possible that this might have been occasioned by some other cause which had escaped my observation, I had the train-oil intentionally omitted, after an interval of a few days, a third time. Though the consequences were not exactly the same as before, the sheep certainly did not appear to feed so greedily as usual. Let us not, however, be surprised at this; what is more common than to see those, whose appetites are accustomed to be pampered, turn with disgust from the most delicious viands, if any particular ingredient has been left out, though reason tells them they are equally salubrious as before; and to any other palate, not vitiated by indulgence, equally as grateful? Why might not animals, therefore, which in a state of fatting may be considered as pampered gluttons, have their appetites in like manner influenced by their food being perceptibly deficient in any of its accustomed flavours?

Whichever of the substances that I have tried may be thought the properest to be made use of, the expense of it will be trifling. According to Mr. Parker's statement, delivered into the committee of the House of Commons, (a very valuable paper, which, in several instances, I have taken as my chemical guide), it appears that the necessary quantity of palm-oil, to adulterate one hundred weight of sugar, will be four pounds; the average expense of which, according to Mr. Parker's statement, will be two shillings and sixpence; of oil of hartshorn fifty-six drops, the expense one penny; of assafœtida twenty-eight grains, the expense fourpence. Having no data to go upon respecting the wholesale price of linseed-oil, or train-oil, I cannot speak to the expense of them with accuracy. They would, I should suppose, be less expensive, particularly train-oil, than palm-oil. But as both these and palm-oil are known to be highly nutritive, they ought not to be considered as enhancing the expense of the sugar more than half their price, as the other half may reasonably be calculated for, in the benefit the cattle will receive by feeding upon them.

Instead, however, of employing any one of these articles singly, it would not be unadvisable to use a composition of several of them together, which would be attended with no more expense than if a single article, especially any of the dearer ones, were used by itself. As thus: instead of mixing, for example's sake, four pounds of palm-oil with one hundred weight of sugar, suppose four pounds of the following mixture were substituted:

Palm-oil, ...	1lb.
Train-oil	1lb.
Urine	2lb.
Emetic-tartar	2oz.
Assafœtida	24 grains.
Oil of hartshorn	28 drops.

In this composition are comprised an animal, a vegetable, and an empyreumatic oil; a substance containing ammoniacal and other salts, metallic calx, and a resinous gum; the whole expense of which would not probably exceed one shilling and eight-pence upon each hundred weight of sugar. In proportion as the chemical processes for separating each of these ingredients from the sugar, and bringing the sugar back to its original state, would by this increased mode of adulteration be multiplied, so would also the difficulties and expense. This, as it would be an insuperable bar to the exertions of chemical skill and ingenuity, however great might be the temptation in this instance to defraud the revenue, would remove every scruple, it is presumed, on the part of Government, to the granting a drawback. Any attempt, indeed, to purify sugar thus contaminated, might seem to be almost as idle as that of the philosopher in the island of Laputa, who undertook, by means of a chemical operation, so to manage the digested food as to resolve it into its constituent principles, and render it fit to be received into the stomach a second time.

It has been proposed, that the drawback upon sugar should be allowed to the farmer on his mixing with it some substance, which will render it unfit for common uses, in the presence of an excise officer. This would be attended with so much trouble and inconvenience to the farmer, as completely to deter him from making use of it altogether. The most practicable way of managing this business, as it appears to me, would be to have some one person, or company, and no more, licensed to sell deteriorated sugar in each mercantile city, or sea-port, where the raw sugars are immediately imported from the West Indies: such person, or company, to be appointed by the sugar planters, consigning their sugars to such city, or sea-port; or by their agents, or repre-

[illegible] or company not to trade di- [illegible], in sugars of any other descrip- [illegible] any distillery or refinery: not to [illegible] warehouses, or possession, any sugars [illegible] notice being first given to the proper officer [illegible] presence the [illegible] substance, [illegible] substances, shall be mixed with [illegible] them to the drawback. [illegible] sent out without a permit. [illegible] supposed that [illegible] and the [illegible]

[illegible]

[illegible]

[illegible] attention of [illegible] ages. [illegible] noticed by Aristotle and Pliny [illegible] and the publications of the different [illegible]

Societies in Europe contain numerous memoirs upon the subject. Notwithstanding the degree of regard bestowed upon the history of luminous animals, it is still very imperfect; the power of producing light appears to have been attributed to several creatures which do not possess it; some species which enjoy it in an eminent degree have been imperfectly described or entirely unobserved; the organs which afford the light in certain animals have not been examined by dissection; and, lastly, the explanations that have been given of the phænomena of animal light are unsatisfactory, and in some instances palpably erroneous.

As this subject forms an interesting part of the history of organized beings, I have for some years availed myself of such opportunities as occurred for its investigation. Having communicated the result of some of my researches to the Right Honourable Sir Joseph Banks, he immediately offered me his assistance with that liberality which so eminently distinguishes him as a real lover of science. I am indebted to him for an inspection of the valuable journal he kept during his voyage with Captain Cook; for permission to copy the original drawings in his possession of those luminous animals discovered in both the voyages of Cook; and for some notes upon the luminous appearance of the sea, that were presented to him by Captain Horsburg, whose accuracy of observation is already known to this learned Society.

In the following paper I shall first examine the grounds on which the property of shewing light has been ascribed to certain animals that either do not possess it, or in which its existence is questionable. I shall next give an account of some luminous species, of which some have been inaccurately described, and others quite unknown. I shall endeavour to explain, from my own observations, and the information communicated to me by others, many of the circumstances attending the luminous appearance of the sea. I shall then describe the organs employed for the production of light in certain species; and, lastly, I shall review the opinions which have been entertained respecting the nature and origin of animal light, and relate the experiments I have made for the purpose of elucidating this part of the subject.

The property of emitting light has been reported to belong to several fishes, more particularly the mackarel, the moon-fish (tetraodon mola), the dorado, mullet, sprat, &c.

Mr. Bajon observed, during the migration of the dorados, &c. that their bodies were covered with luminous points. These however proved, upon examination, to be mere spherical particles that adhered to the surface of these fishes; and, he adds, appeared to be precisely the same sort of points that illuminated the whole of the sea at the time. They were therefore, in all probability, the minute kind of medusa which I shall have occasion to describe hereafter.

Godeheu de Riville states, in a paper sent to the Academy of Sciences at Paris, that on opening the scomber pelamis while alive, he found in different parts of its body an oil which gave out much light: but it should be observed, that Riville had a particular theory to support, for which this fact was very convenient, and that other parts of his memoir bear marks of inaccuracy. It may be added, that if the oil of fishes were usually luminous, which Riville supposed, it would be almost universally

niversally known, instead of resting on a solitary bservation.

As far as I am able to determine from what I have seen, the faculty of exhibiting light during life does not belong to the class of fishes. It appears probable, that some fishes may have acquired the character of being luminous from evolving light soon after death.

Some species of lepas, murex, and chama, and some star-fish, have been said to possess the power of shining; and the assertion has been repeated by one writer after another, but without quoting any authority.

Brugueire upon one occasion saw, as he supposed, common earth-worms in a luminous state; all the hedges were filled with them; he remarked that the light resided principally in the posterior part of the body *.

Flaugergues pretended to have seen earth-worms luminous in three instances; it was at each time in October; the body shone at every part, but most brilliantly at the genital organs †.

Notwithstanding this concurrence of testimony, it is next to impossible that animals so frequently before our eyes as the common earth-worm should be endowed with so remarkable a property without every person having observed it. If they only enjoyed it during the season for copulation, still it could not have escaped notice, as these creatures are usually found joined together in the most frequented paths, and in garden-walks.

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* Journal d'Histoire Naturelle, tome II.

† Journal de Physique, tome XVI.

In different Systems of Natural History the property of shining is attributed to the cancer pulex. The authorities for this opinion are Hablitzl, and Thules and Bernard. The former observed, upon one occasion, a cable that was drawn up from the sea exhibit light, which upon closer inspection was perceived to be covered by these insects *. Thules and Bernard reported that they met with a number of this species of cancer on the borders of a river entirely luminous†. I am nevertheless disposed to question the luminous property of the cancer pulex, as I have often had the animal in my possession, and never perceived it emit any light.

The account given by Linneus of the scolopendra phosphorea is so improbable and inconsistent that one might be led to doubt this insect's existence, particularly as it does not appear to have been ever seen, except by Ekeberg, the Captain of an East Indiaman, from whom Linneus learnt its history.

I now proceed to the description of those luminous animals that have been discovered by the Right Honourable Sir Joseph Banks, Captain Horsburg, and myself.

On the passage from Madeira to Rio de Janeiro, the sea was observed by Sir Joseph Banks to be unusually luminous, flashing in many parts like lightning. He directed some of the water to be hauled up, in which he discovered two kinds of animals that occasioned the phænomenon; the one, a crustaceous insect, which he called the cancer fulgens; the other, a large species o medusa, to which he gave the name of pellucens.

The cancer fulgens bears some resemblance to th common shrimp; it is however considerably less; th

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* Hablitzl ap. Pall. n. Nord. Beytr. 4, p. 396.

† Journal de Physique, tome XXVIII.

legs are furnished with numerous setæ. The light of this animal, which is very brilliant, appears to issue from every part of the body.

The medusa pellucens measures about six inches across the crown or umbella; this part is marked by a number of opake lines, that pass off from the center to the circumference. The edge of the umbella is divided into lobules, which succeed each other, one large and two small ones alternately. From within the margin of the umbella there are suspended a number of long cord-shaped tentacula. The central part of the animal is opake, and furnished with four thick irregularly-shaped processes, which hang down in the midst of the tentacula.

This zoophyte is the most splendid of the luminous inhabitants of the ocean. The flashes of light emitted during its contractions are so vivid as to affect the sight of the spectator.

In the notes communicated to Sir Joseph Banks by Captain Horsburg he remarks that the luminous state of the sea between the Tropics is generally accompanied with the appearance of a great number of marine animals of various kinds upon the surface of the water; to many of which he does not, however, attribute the property of shining. At other times, when the water which gave out light was examined it appeared only to contain small particles of a dusky straw colour, which dissolved with the slightest touch of the finger. He likewise observes, that in Bombay, during the hot weather of May and June, he has frequently seen the edges of the sea much illuminated by minute sparkling points.

At sun-rise on April 12, 1798, in the Arabian Sea, he perceived several luminous spots in the water, which conceiving to be animals, he went in the boat and caught one. It proved to be an insect somewhat resembling in appearance the wood-louse, and was about one third of an inch in length. When viewed with the microscope it seemed to be formed by sections of a thin crustaceous substance. During the time that any fluid remained in the animal it shone brilliantly, like the fire-fly.

In the month of June in the same year he picked up another luminous insect on a sandy beach, which was also covered with a thin shell, but it was a different shape, and a larger size than the animal taken in the Arabian Sea.

By comparing the above description with an elegant pen and ink drawing which was made by Captain Horsburg, and accompanied his paper, I have no doubt that both these insects were monoculi; the first evidently belongs to the genus limulus of Muller; I shall therefore beg leave to distinguish it by the name of limulus noctilucus.

My pursuits and the state of my health having frequently led me to the coast, I have had many opportunities of making observations upon the animals which illuminate our own seas. Of these I have discovered three species: one of which is a beroe not hitherto described by authors; another agrees so nearly with the medusa hemispherica that I conceive it to be the same, or at least a variety of that species; the third is a minute species of medusa, which I believe to be the luminous animal so frequently seen by navigators, although it has never been distinctly examined or described.

I first met with these animals in the month of October 1804, at Herne Bay, a small watering-place upon the Northern coast of Kent. Having observed the sea to be extremely luminous for several nights, I had a considerable quantity of the water taken up. When perfectly at rest, no light was emitted; but on the slightest agitation of the vessel in which the water was contained, a brilliant scintillation was perceived, particularly towards the surface; and when the vessel was suddenly struck, a flash of light issued from the top of the water, in consequence of so many points shining at the same moment. When any of these sparkling points were removed from the water, they no longer yielded any light. They were so transparent that in the air they appeared like globules of water. They were more minute than the head of the smallest pin. Upon the slightest touch they broke and vanished from the sight. Having strained a quantity of the luminous water, a great number of these transparent corpuscles were obtained upon the cloth, and the water which had been strained did not afterwards exhibit the least light. I then put some sea-water that had been rendered particularly clear, by repeated filtrations, into a large glass, and having floated in it a fine cloth, on which I had previously collected a number of luminous points, several of them were liberated, and became distinctly visible in their natural element, by placing the glass before a piece of dark-coloured paper. They were observed to have a tendency to come to the surface of the water; and after the glass was set by for some time, they were found congregated together,

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and when thus collected in a body they had a dusky straw colour, although individually they were so transparent as to be perfectly invisible, except under particular circumstances. Their substance was indeed so extremely tender and delicate, that they did not become opaque in distilled vinegar or alcohol until immersed in these liquors for a considerable time.

On examining these minute globules with the microscope, I found that they were not quite perfect spheres, but had an irregular depression on one side, which was formed of an opaque substance, that projected a little way inwards, producing such an appearance as would arise from tying the neck of a round bag, and turning it into the body.

The motions of these creatures in the water were slow and graceful, and not accompanied by any visible contraction of their bodies. After death they always subsided to the bottom of the vessel.

From the sparkling light afforded by this species I shall distinguish it by the name of medusa scintillans.

The night following that on which I discovered the preceding animal I caught the two other luminous species. One of these I shall call the beroe fulgens.

This most elegant creature is of a colour changing between purple, violet, and pale blue; the body is truncated before, and pointed behind; but the form is difficult to assign, as it is varied by partial contractions, at the animal's pleasure. I have represented the two extremes of form that I have seen this creature assume: the first is somewhat that of a cucumber, which, as being the one it takes when at rest, should perhaps be considered as its proper shape: the other resembles a pear, and is the figure it has in the most contracted state. The body is hollow, or forms internally an infundibular cavity, which has a wide opening before, and appears also to have a small aperture posteriorly, through which it discharges its excrement. The posterior two-thirds of the body are ornamented with eight longitudinal ciliated ribs, the processes of which are kept in such a rapid rotatory motion, while the animal is swimming, that they appear like the continual passage of a fluid along the ribs. The ciliated ribs have been described by Professor Mitchell, as arteries, in a luminous beroe, which I suspect was no other than the species I am now giving an account of.

When the beroe fulgens swam gently near the surface of the water, its whole body became occasionally illuminated in a slight degree; during its contractions a stronger light issued from the ribs; and when a sudden shock was communicated to the water, in which several of these animals were placed, a vivid flash was thrown out. If the body were broken, the fragments continued luminous for some seconds, and being rubbed on the hand, left a light like that of phosphorus: this however, as well as every other mode of emitting light, ceased after the death of the animal.

The hemispherical species that I discovered had a very faint purple colour. The largest that I found measured about three quarters of an inch in diameter. The margin of the umbella was undivided, and surrounded internally by a row of pale brown spots, and numerous small twisted tentacula; four opaque lines crossed in an arched manner from the circumference, towards the centre of the animal: an opaque irregular-shaped process hung down from the middle of the umbella: when this part was examined with a lens of high powers I discovered that it was inclosed in a sheath in which it moved, and that the extremity of the process was divided into four tentacula, covered with little cups or suckers, like those on the tentacula of the cuttle-fish.

This species of medusa bears a striking resemblance to the figures of the medusa hemispherica, published by Gronovius and Muller; indeed it differs as little from these figures, as they do from each other. Its luminous property, however, was not observed by these naturalists, which is the more extraordinary, as Muller examined it at night, and says it is so transparent, that it can only be seen with the light of a lamp. If it should be still considered as a distinct species, or as a variety of the hemispherica, I would propose to call it the medusa lucida.

In this species, the central part and the spot round the margin, are commonly seen to shine on lifting the animal out of the water into the air, presenting the appearance of an illuminated wheel, and when it is exposed to the usual percussion of the water, the transparent parts of its body are alone luminous.

In the month of September 1805, I again visited Herne Bay, and frequently had opportunities of witnessing the luminous appearance of the sea. I caught many of the hemispherical and minute species of medusa, but not one of the beroe fulgens. I observed that these luminous animals always retreated from the surface of the water, as soon as the moon rose. I found also, that exposure to the day light took away their property of shining, which was revived by placing them for some time in a dark situation.

In that season I had two opportunities of seeing an extended illumination of the sea, produced by the above animals. The first night I saw this singular phenomenon was extremely dark; many of the medusa scintillans and medusa hemispherica had been observed at low water, but on the return of the tide, they had suddenly disappeared. On looking towards the sea, I was astonished to perceive a flash of light of about six yards broad, extend from the shore, for apparently the distance of a mile and a half along the surface of the water. The second time that I saw this sort of light proceed from the sea, it did not take the same form, but was diffused over the surface of the waves next the shore, and was so strong, that I could for the moment distinctly see my servant, who stood at a little distance from me: he also perceived it, and called out to me at the same instant. On both these occasions the flash was visible for about four or five seconds, and although I watched for it a considerable time, I did not see it repeated.

A diffused luminous appearance of the sea, in some respects different from what I have seen, has been described by several navigators.

Godeheu de Riville saw the sea assume the appearance of a plain of snow on the coast of Malabar *.

Captain Horsburgh, in the notes he gave to Sir Joseph Banks, says, there is a peculiar phenomenon sometimes seen within a few degrees' distance of the coast of Malabar, during the rainy monsoon, which he had an opportunity of observing. At midnight the weather was cloudy, and the sea was particularly dark, when suddenly it changed to a white flaming colour all around.

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* Mem, Etrang. de l'Acad. des Sc. Tom. 3.

This bore no resemblance to the sparkling or glowin appearance he had observed on other occasions in se near the equator, but was a regular white colour, lik milk, and did not continue more than ten minutes. A similar phenomenon, he says, is frequently seen in th Banda sea, and is very alarming to those who have neve perceived or heard of such an appearance before.

This singular phenomenon appears to be explained b some observations communicated to me by Mr. Langstaff, a surgeon in the city, who formerly made several voyages. In going from New Holland to China, about half a hour after sunset, every person on board was astonished by a milky appearance of the sea: the ship seemed t be surrounded by ice covered with snow. Some of th company supposed they were in soundings, and tha coral bottom gave this curious reflection, but on sounding with 70 fathoms of line no bottom was met with. A bucket of water being hauled up, Mr. Langstaff examined it in the dark, and discovered a great number o globular bodies, each about the size of a pin's head, linked together. The chains thus formed did not exceed three inches in length, and emitted a pale phosphoric light. By introducing his hand into the water, Mr. Langstaff raised upon it several chains of the luminous globules, which were separated by opening the fingers, but readily re-united on being brought again into contact, like globules of quick-silver. The globules, he says, were so transparent, that they could not be perceived when the hand was taken into the light.

This extraordinary appearance of the sea was visible for two nights. As soon as the moon exerted her influence, the sea changed to its natural dark colour, an exhibited distinct glittering points, as at other times

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The phenomenon, he says, had never been witnessed before by any of the company on board, although some of the crew had been two or three times round the globe.

I consider this account of Mr. Langstaff very interesting and important, as it proves that the diffused light of the sea is produced by an assemblage of minute medusæ on the surface of the water.

In June 1806, I found the sea at Margate more richly stored with the small luminous medusæ, than I have ever seen it. A bucket of the water being set by for some time, the animals sought the surface, and kept up a continual sparkling, which must have been occasioned by the motions of individuals, as the water was perfectly at rest. A small quantity of the luminous water was put into a glass jar, and on standing some time, the medusæ collected at the top of the jar, and formed a gelatinous mass, one inch and a half thick, and of a reddish or mud colour, leaving the water underneath perfectly clear.

In order to ascertain if these animals would materially alter their size, or assume the figure of any other known species of medusa, I kept them alive for 25 days, by carefully changing the water in which they were placed; during which time, although they appeared as vigorous as when first taken, their form was not in the slightest degree altered, and their size but little increased. By this experiment I was confirmed in the opinion of their being a distinct species, as the young actiniæ and medusæ exhibit the form of the parent in a much shorter period than the above.

In September 1806, I took at Sandgate a number of the beroe fulgens, but no other species: they were of various dimensions, from the full size down to that of the medusa scintillans: they could however be clearly distinguished from the latter species, by their figure.

Since that time, I have frequently met with the medusa scintillans on different parts of the coast of Sussex, at Tenby, and at Milford haven. I have likewise seen this species in the bays of Dublin and Carlingford in Ireland.

In the month of April, last year, I caught a number of the beroe fulgens in the sea at Hastings; they were of various sizes, from about the half of an inch in length, to the bulk of the head of a large pin. I found many of them adhering together in the sea; some of the larger sort were covered with small ones, which fell off when the animals were handled, and by a person unaccustomed to observe these creatures, would have been taken for a phosphoric substance. On putting a number of them into a glass, containing clear sea water, they still shewed a disposition to congregate upon the surface. I observed that when they adhered together, they shewed no contractile motion in any part of their body, which explains the cause of the pale or white colour of the diffused light of the ocean. The flashes of light which I saw come from the sea at Herne bay, were probably produced by a sudden and general effort of the medusæ to separate from each other, and descend in the water.

The medusa scintillans almost constantly exists in the different branches of Milford haven that are called pills. I have sometimes found these animals collected in such vast numbers in those situations, that they bore a considerable proportion to the volume of the water in which they were contained: thus, from a gallon of sea water in a luminous state, I have strained above a pint of these medusæ. I have found the sea under such circumstances to yield me more support in swimming, and the water to taste more disagreeably than usual; probably the difference of density, that has been remarked at different times in the water of the sea, may be referred to this cause.

All my own observations lead me to conclude, that the medusa scintillans, is the most frequent source of the light of the sea around this country, and by comparing the accounts of others with each other, and with what I have myself seen, I am persuaded that it is so likewise in other parts of the world. Many observers appear to have mistaken this species for the nereis noctiluca, which was very natural, as they were prepossessed with the idea of the frequent existence of the one, and had no knowledge of the other. Some navigators have actually described this species of medusa, without being aware of its nature. Mr. Bajon, during his voyage from France to Cayenne, collected many luminous points in the sea, which he says, when examined by a lens, were found to be minute spheres. They disappeared in the air. Doctor Le Roy, in sailing from Naples to France, observed the sparkling appearance of the sea, which is usually produced by the medusa scintillans. By filtering the water, he separated luminous particles from it, which he preserved in spirits of wine: they were, he says, like the head of a pin, and did not at all resemble the nereis noctiluca, described by Vianelli; their colour approached a yellow brown, and their substance was extremely tender, and fragile. Notwithstanding this striking resemblance to the medusa scintillans, Le Roy, in consequence of a preconceived theory, did not

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le, by being a long time preserved in spirits, which
re laid before this learned Society, it will be found,
the only difference between Forster's animalcule,
the medusa scintillans, is in the appearance of the
ne parts, shewn in the microscopic views.

any writers have ascribed the light of the sea to
r causes than luminous animals. Martin supposed it
s occasioned by putrefaction; Silberschlag believed
be phosphoric; Professor J. Mayer conjectured
the surface of the sea imbibed light, which it after-
ls discharged. Bajon and Gentil thought the light
he sea was electric, because it was excited by fric-
. Forster conceived that it was sometimes electric,
times caused from putrefaction, and at others by
presence of living animals. Fougeroux de Bonda-
believed that it came sometimes from electric fires,
more frequently from the putrefaction of marine
als and plants.

shall not trespass on the time of the Society to refute
above speculations; their authors have left them
pported by either arguments or experiments, and
are inconsistent with all ascertained facts upon this
ect.

he remarkable property of emitting light during life
ly met with amongst animals of the four last classes
nodern naturalists, viz. Mollusca, Insects, Worms,
Zoophytes.

he mollusca and worms contain each but a single
inous species; the *pholas dactylus* in the one, and
nereis noctiluca in the other.

me species yield light, in the eight following ge-
of insects: *elater, lampyris, fulgora, pausus, sco-*

lopendra, *cancer*, *lynceus*[*], and *limulus*. The luminous species of the genera lampyris and fulgora are more numerous than is generally supposed, if we may judge from the appearance of luminous organs, to be seen in dried specimens.

Amongst zoophytes we find that the genera *medusa*, *beroe*[†], and *pennatula*, contain species which afford light.

The only animals which appear to possess a distinct organization for the production of light are the luminous species of lampyris, elater, fulgora, and pausus.

The light of the lampyrides is known to proceed from some of the last rings of the abdomen, which, when not illuminated, are of a pale yellow colour. Upon the internal surface of these rings there is spread a layer of a peculiar soft yellow substance, which has been compared to paste, but by examination with a lens I found it to be organized like the common interstitial substance of the insect's body, except that it is of a closer texture, and a paler yellow colour. This substance does not entirely cover the inner surface of the rings, being more or less deficient along their edges, where it presents an irregular waving outline. I have observed in the glow-worm that it is absorbed, and its place supplied by common interstitial substance, after the season for giving light is past.

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[*] The animal discovered by Riville off the coast of Malabar in 1754 is certainly a testaceous insect, and appears to belong to the genus lynceus of Muller.

[†] The luminous zoophyte for which Peron has lately instituted the new genus pyrosoma, appears to me to be a beroe, and only worthy of a specific distinction.

The segments of the abdomen, behind which this peculiar substance is situated, are thin and transparent, in order to expose the internal illumination.

The number of luminous rings varies in different species of lampyris, and, as it would seem, at different periods in the same individual.

Besides the luminous substance above described, I discovered in the common glow-worm, on the inner side of the last abdominal ring, two bodies, which to the naked eye appear more minute than the head of the smallest pin. They are lodged in two slight depressions, formed in the shell of the ring, which is at these points particularly transparent. On examining these bodies under the microscope I found that they were sacs containing a soft yellow substance, of a more close and homogeneous texture than that which lines the inner subface of the rings. The membrane forming the sacs appeared to be of two layers, each of which is composed by a transparent silvery fibre, in the same manner as the internal membrane of the respiratory tubes of insects; except that in this case the fibre passes in a spiral instead of a circular direction. This membrane, although so delicately constructed, is so elastic as to preserve its form after the sac is ruptured and the contents discharged.

The light that proceeds from these sacs is less under the controul of the insect than that of the luminous substance spread on the rings: it is rarely ever entirely extinguished in the season that the glow-worm gives light, even during the day; and when all the other rings are dark, these sacs often shine brightly.

TO BE CONCLUDED IN OUR NEXT.

Memoir on the Means of ascertaining and comparing the Strength of Horses. By M. REGNIER.

From the ANNALES DE CHIMIE.

With a Plate.

WHEN I first began to make use of the apparatus* to ascertain and compare the strength of horses, the instrument called the dynanometer was attached to a fixed point; but experience has shewn that the results are often irregular, either owing to the sudden pulls of the animal, or to the counter strokes which carry the needle on the dial to a higher degree than that which should shew the amount of the action of the horse.

To remedy this inconvenience, I have resorted to the expedient of hooking the dynanometer to a rope fastened at each end upon a bow of ash wood, Fig. 2, which is composed of six boards placed flatwise upon each other. These boards are fastened together by a screw pin through the middle, and by bandages of cord at convenient distances, like the steel plates that form the springs of coaches.

This large and strong bow is placed for support behind the trunk of a tree, or a post that is rounded and firmly fixed in the ground.

One end of the dynanometer is hooked to the rope on the bow, and the other to the stretch-staff to which the horse draws.

It may be easily imagined that by causing the horse, whose strength we wish to ascertain, to advance, the bow will

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* M. Regnier is the inventor of this instrument, see Plate XV. which he calls a dynanometer, because it serves to ascertain and compare the relative strength of men, horses, and all beasts of burden.

Fig. 4.

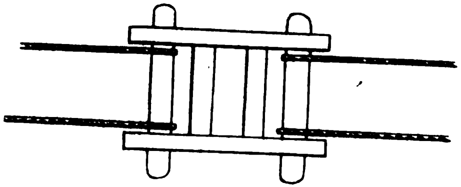


Fig. 5.

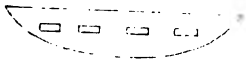


Fig. 1.

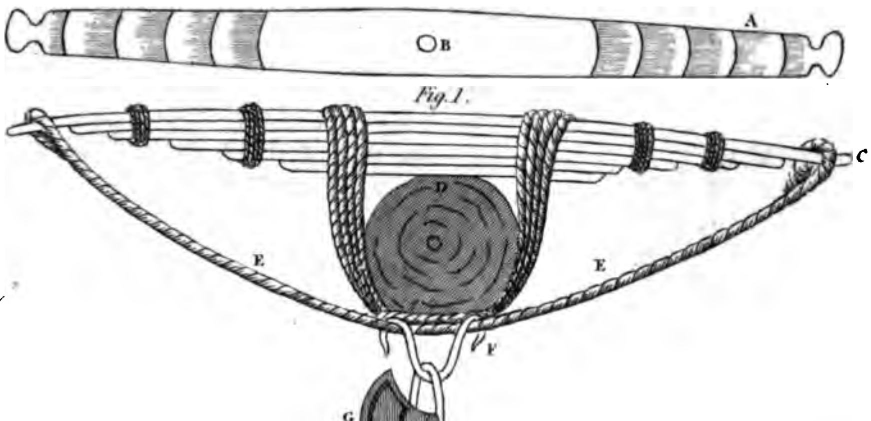
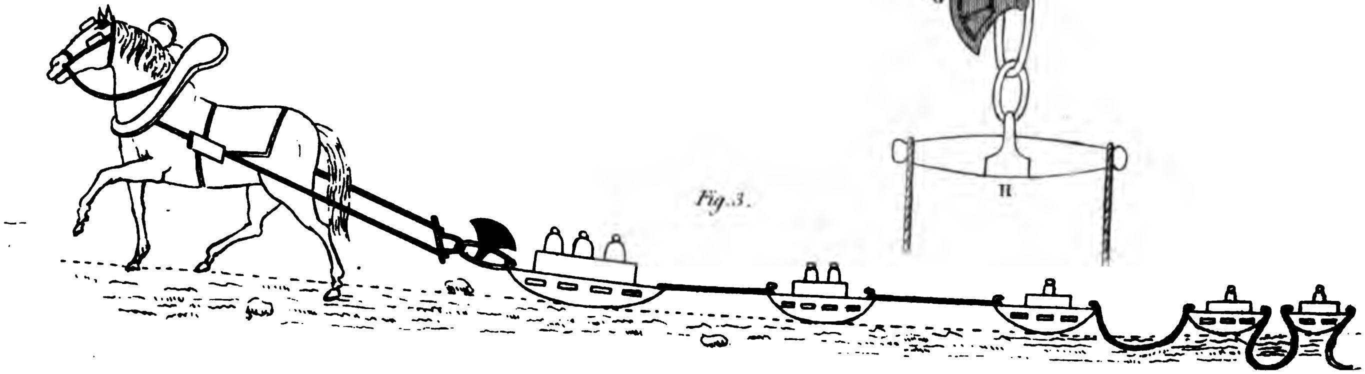


Fig. 3.



bend, and the instrument will follow its elastic movements without suffering any counter blows; and, that the horse feeling the resistance of the obstacle that opposes his action, will redouble his efforts to surmount it.

Fig. 1. (Plate XV.) shews the disposition of the apparatus.

A A, Fig. 2, is a plan of the bow composed of six boards of good ash, 13 millemetres in thickness, and 16 centimetres wide, and narrowed towards the end.

B, the hole intended to receive the screw-pin which fastens the boards together.

C, A profile view of the bow.

D, the stump of a tree that sustains the bow. It is fastened to it by a cordage raised about a yard from the ground, that is, as high as the breast of the horse.

E E, the rope of the bow to which the dynanometre is hooked.

G, the dynanometer with a jointed link that is passed through the ring of the stretch-staff.

H, the stretch-staff furnished with its traces, to which the horse is fastened.

Observations.

On proceeding to the experiment, a low stool or bench covered with straw, should be placed near the foot of the tree, that the instrument may not drag upon the ground, and that it may naturally rest upon the cushion when the horse stops.

The horse should also be made to set off gently without the whip, in order that the amount of the simple muscular strength may be obtained, and not that which would be produced by a sudden motion which might vary in proportion to the space passed over. The only thing to be considered here is the action of a horse striving to overcome the resistance of a body at rest.

Many carriers have assured me that a horse which acts upon the dynanometer to the amount of forty myriagrammes, will draw a two-wheeled cart, loaded with four thousand weight, and one that can raise it to fifty myriagrammes will draw five thousand weight, not to a great distance, but for a quarter of a league on a paved horizontal road. Thus the relation that exists between the division of the dynanometer, and the weight that a horse can draw in a two-wheeled cart, merits attention, as it shews immediately what weight any horse is capable of drawing to a certain distance. By this means the strength of draught horses may be proved without danger, and the most spirited are easy to be distinguished from the others.

Result of Experiments made at the central Dépôt of Artillery, October 10, 1807*:* 1*st. on four Horses intended to shew the military Equipages which had all nearly the same Appearance, and were of the Age prescribed by the Regulations.* 2*dly. On three Carriers' Horses from Paris,*

	Number of proofs.	Action exercised by the horse.	Mean term.
1st. horse	1	31 myriagr.	30 myriagr.
	2	29	
2d	1	41	41
	2	41	
3d	1	35	33½
	2	32	
4th	1	39	41½
	2	44	

Experiments on the three Carriers' Horses.

1st. horse	1	37 myriagr.	37 myriagr.
	2	37	
2d	1	38	39
	2	40	
3d	1	54	52½
	2	54	

Although the arc above described completely fulfils its object, I agree, with several others, in thinking that it would be advantageous to give more motion to the action of the horse.

For this end I have contrived another method, which affords a gradually-encreasing resistance, and allows the horse to go to the length of 60 feet.

This method consists in employing eleven small sledges, which are fastened behind each other by cords 2 metres (6 feet) long, and that are caught by hooks at each end of the sledges.

The first of these sledges, which is hooked on to the dynanometre, (see Fig. 3,) carries a weight of 30 myriagrammes, the other ten carry only from 75 to 50 kilogrammes. They are placed in a line very near to each other.

Figs. 4 and 5 give different views of the sledges on a larger scale than those described in Fig. 3.

Manner of using the Apparatus.

When the horse is attached to one end of the apparatus, called the dynanometer, and the other end is hooked on to the first sledge, the horse being put in motion, draws the first sledge six feet forward before its movement affects the second, which in its turn draws the third to the same distance, and so on, successively, until the horse is arrested in his progress by the resistance of the accumulated weight. The index of the dynanometer indicates the degrees of strength he has exerted in drawing the number of sledges that he has been able to move.

Although the sledges might be loaded with a given weight, yet the assistance of the dynanometer is indispensible, because no land is exactly alike in all places; and on the same road there will be found many inequalities that will oppose various degrees of resistance, and the graduations of the instrument indicate in an incontestable manner, the exact degree of strength that the horse has employed.

A rising road is preferable for these experiments, because it renders less weight necessary, and the sledges are more easily returned to their places for the purpose of renewing the experiment.

It is essential to observe, that the horse should not be allowed to stop during the experiment, as in resuming his pace, he would unavoidably cause a number of counter-blows; he should therefore be urged on till he can go no further.

Thus are we enabled to prove the strength of beasts of draught in different way's, which have each their particular advantage; but the second appears to be preferable to the first, as it shews at the same time the degree of friction sustained on different ground, and ascertains the degree of resistance that the sledges oppose in transporting merchandize, &c.

In employing the dynanometer, M. Péron, a naturalist of distinguished merit, has been led to observe, that savage people have invariably less strength than the civilized; and thus it is demonstrated, that the improvement of social order does not impair our physical powers, as some persons have imagined. It may not be unacceptable to insert in this place the result of M. Péron's experiments on this subject, that have been published.

Comparative Experiments on the Strength of Savages and Europeans.

Savages.	Strength of the hands. Kilogrammes.		Strength of the loins. Myriagrammes.	
Of Diemnsland	50	6	0	0
Of New Holland	51	8	14	8
Of Timor	58	7	16	2
Europeans that were on the spot, or had previously made the Experiment.				
French	69	2	22	1
English	71	4	23	8

An Account of the Improvements in M. MONGOLFIER'S *Hydraulic Ram.*

With an Engraving.

From the BIBLIOTHEQUE PHISYCO-ECONOMIQUE.

WE have given in the first volume of this work a description and print of M. Mongolfier's hydraulic ram; since which time this ingenious man, to whom the public is indebted for the invention of a machine of so much utility, has not ceased his endeavours to improve, and especially to render it, by the simplicity and firmness of all its parts, serviceable to agriculturists and manufacturers. He has communicated to us these improvements,

provements, and the engraving in the annexed plate represents the most important results of the researches and experiments of six years.

This plate exhibits a vertical section of the hydraulic ram, adapted to a small stream, the water of which is confined and retained at its greatest height by a bank of brick-work.

A, Fig. 1, (Plate XIV.) the upper surface of the water on the bank. B, the bank. C, Fig. 2, an arched cell closed by a door. D D, section of the earth in which the apparatus is fixed. E, Fig. 1, an iron grating placed before the entrance of the body of the ram. F G, the entrance of the body of the ram, widening into a funnel, to facilitate the entrance of the water. This piece is fixed with cement into the solid brick-work. H H, Figs. 1 and 2, parts of the upper and lower pipes which form the body of the ram; the total length of this conduit varies from fifty to a hundred feet, according to the height of the fall. The diameter is the same as at the mouth of the ram. I, Fig. 2, the head of the ram properly speaking. This piece contains all the mechanism. K L, a pipe by which the water runs off. M M, stones that support the pipes and the head of the ram.

The ram is represented as broken because its whole length could not be given without diminishing the scale considerably.

Particular Description of the Head of the Ram.

a, fig. 2, a reservoir of air communicating with the head I by the opening that contains the ball or ascending valve *c*. *b*, frame of the ascending valve furnished with shields of leather at the bottom. *c*, the ascending valve or ball. *d*, a small shifting valve, opening the sixth of an inch within the head. *e*, a stop-valve or ball of hollow metal. *f*, the large orifice of the ram, by which the water escapes; it is furnished with shields of leather. *g*, a sort of muzzle composed of six bars of metal to contain the ball *e*, at a convenient distance from the orifice *f*. There is one similar to it, but smaller at the ascending valve *c*. *h*, the ascending pipe joined to the reservoir of air by two staples and screws. This pipe may be extended two feet under the earth, if there are no obstacles to prevent it from conveying the water to the appointed place. It should be furnished with a small cock at the point *h*, by which it may be emptied in hard frosts and during repairs.

The body of the ram F G H may be constructed of cast iron, hammered copper, or cast lead. The pipe of ascension *h*, of cast iron, hammered copper, cast and rolled lead, and even of wood for small heighths. The heads must be composed either of cast iron or copper.

For the bank A may be substituted a simple bank of earth supported by piles entwined with strong hurdles.

A foot or two before the entrance of the body of the ram, should be placed a grating composed either of iron, copper, wood, or lead, sufficiently close to prevent the admission of rushes, leaves, or any other foreign substances. It must be at least five times as large as the surface of a section of the pipe, and must be frequently cleansed.

In comparing this machine with that described in our first volume in 1802, we perceive the difference to be,

1st. In the enlargement of the entrance to the body of the ram, which facilitates the admission of the water, and thus augments the product of the machine.

2d. In place of the small stop-valves and ascending valves are substituted hollow balls of metal, which are much more simple and firm, are less liable to be stopped by the casual intervention of foreign substances, and are more easily replaced in case of accident. Besides, as they oppose less resistance to the passage of the water, they also augment the product.

3d. The addition of the small shifting valve, which serves to introduce at each movement a quantity of air into the head of the ram, from whence it is driven by the next movement into the reservoir *a*, which would be soon filled with water, if the air, absorbed by the contact of the water under a strong pressure, were not continually replaced by this means.

4th. The space between the frame of the ascending valve *b*, and the interior sides of the head of the ram, contains a volume of air which cannot be forced into the reservoir; but which at each movement is compressed by and receives the first effort of the moving water. Thus the shutting of the balls or valves make less noise, and all the operations take place with so much ease that the machine is less shaken and less frequently out of repair.

5th, and lastly, he has endeavoured to diminish, as much as possible, the number of pieces that compose the apparatus, and the screws that are necessary to fasten them together.

THE

REPERTORY

OF

ARTS, MANUFACTURES,

AND

AGRICULTURE.

No. CVIII. SECOND SERIES. May 1811.

Specification of the Patent granted to WILLIAM MURDOCK, *of Soho Foundry, in the Parish of Harborne, in the County of Stafford, Engineer; for an improved Method or Process for boring and forming Pipes, Cylinders, Columns, and circular Disks, out of solid Blocks and Slabs of Stone, of any Kind or Description.*

Dated January 15, 1810.

With a Plate.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said William Murdock do hereby describe and ascertain the nature of my said invention, and the manner in which the same is to be performed, as follows; that is to say: When I intend to form a pipe or hollow cylinder of stone, instead of boring, cutting out, or grinding to powder the whole inside contents of the same, I cut, grind, or saw out of it, in manner hereinafter described, a core or solid cylinder, whose outside diameter is about half an inch less than the inside diameter of the pipe. And in like manner, when I intend to form a column or solid cylinder, or a round plate of stone, instead of breaking off, cutting, or chizzeling away the superfluous parts of the stone, I form, by a similar method, these superfluous parts of the stone into a hollow cylinder, the core thereof being the required solid cylinder. And if the stone is large enough to leave the outside parts of a proper thickness, they may be used as a pipe, and the cores cut out of the larger sorts of pipes I use as columns; or, by a farther operation, form them into smaller pipes; so that in some cases I cut several out of one another, and thus save labour and stone. I perform these operations of perforating and rounding the said pipes or columns as follows.

First. I fix the block of stone to be perforated or rounded upright, or in such a position that the bore or perforation, or intended column, may be nearly perpendicular to the horizon, or if a disk or round plate is to be formed or cut out of a flat stone or slab, that the upper surface may lie nearly horizontal.

Second. I fix in the centre of the intended pipe or column a plug or step of wood or metal, (see Z, Plate XVI.) having in its centre a hole, which shall fit the pivot of the perpendicular axis or spindle A, next mentioned.

Third. I place in the said step the pivot of the axis or spindle A, considerably longer than the pipe or column to be formed, and of a size or thickness proportioned to the work to be done. This rod or spindle I make square or triangular, or cylindrical, with a groove or grooves in it, or of any other form on which sockets may slide up and down without being able to turn round on it; but whatever may be the form of its section, I make it uniformly thick, or of one size from end to end, as far as the tube is to slide upon it.

Fourth. Upon the upper end of this axis or spindle I fix a hollow socket B B, which fits tight upon the spindle. The middle part of the outside of this socket I make square, but it may be of any other convenient form to receive a pulley C C, (or a small toothed wheel or pinion,) by which the axis or spindle may be turned round, but the upper and lower parts of the socket are cylindrical, to serve as gudgeons, on which it turns round in a fixed wooden, iron, or other frame of suitable materials, such as D D, as shewn in the said plate. Upon or near the lower end of the axis or spindle, near to the stone to be bored, I fix or attach a wheel or cross J J, with arms, and having a hole in the centre, which the axis or spindle fits; and the circumference of this wheel or cross is made like a hoop, two or three inches or more broad or deep. Its diameter is a little less than that of the pipe intended to be bored, or a little more than that of the cylinder or core intended to be formed, and fits to the inside of the tube L L, so as the latter may slide easily over it. It is fixed fast to the spindle by a screw, pin, or key, so that it may be taken off at pleasure. This wheel or cross J J, I call the fixed or lower wheel or cross. The upper part of the axis or spindle is perforated longitudinally to O, a few inches below the socket, where the perforation comes out obliquely.

Fifth. Upon this axis or spindle, and concentric with it, I place a hollow cylinder or thin tube L L, of iron, copper, or brass, or any other proper material, its diameter being nearly that of the pipe or cylinder to be formed, and the length exceeding the length of the proposed pipe or cylinder by about two feet or more. This pipe is made as truly cylindrical as possible. In its lower edge is fixed, by means of tin solder, rivets, screws, or otherwise, a hoop or ring M M, of iron, copper, or other proper material, so much thicker than the tube, that the groove it makes in the stone may free the tube to which it is attached. This hoop or ring being intended to grind or cut away the stone by its lower edge, the said lower edge is left either smooth or may be cut or jagged like the saws used by stone cutters. I call this the saw; its thickness may be varied according to the size of the tube, so as to give the necessary strength and liberty for the tube to act, but the thinner the tube is made, preserving the necessary strength, the better. The tube is connected with the axis or spindle by means of a second wheel or cross K K, which I call the upper wheel or cross, which is fixed or attached by its circumference to the inside of the tube, having a hole in its centre which fits the axis or spindle, so as to slide up and down easily upon it, without being able to turn round upon it, which is prevented by the form of the axis or spindle being square, triangular, or round, with a longitudinal groove or grooves, in which a feather or tongue can slide, or is of some other proper form, and that of the hole in this wheel or cross which fits it. The tube then can be slid up or down upon the axis or spindle, and is kept always concentric with it by reason of this wheel or cross, and the lower wheel or cross. To one of the arms of this upper wheel or cross is fixed a small cord P P, or a chain, rod, or rack, which passes upwards through the perforation of the axis or spindle, and over a pulley Q, fixed at some convenient height above it; this I describe as the most simple, and, from that pulley to a windlass R to which it is attached, the use of which is to raise or lower the tube upon the axis or spindle, as required, even while the latter is in motion. On the upper end of the tube I place weights N N, proportioned to the texture and hardness of the stone to be bored, which tend to press it downwards, and cause it to act upon and penetrate the stone.

Sixth. The pulley or pinion C C is fixed upon the socket which receives the upper end of the axis or spindle; this I generally make about twice the diameter of the tube, or of the inside of the pipe to be bored; but it may be made larger or less, according to circumstances. When the apparatus is to be put in motion by men's force, I use generally a pulley (as shewn in the drawing). A rope E E is wound round this pulley, the ends of which pass over two other pullies F F, fixed one on each side of the spindle, as represented in the drawing, and at some convenient distance from it. The ends of this rope then turn downwards, and having handles GG fixed to them, are pulled alternately by a man at each end, so as to cause the spindle and pulley to make a reciprocating or alternate rotative motion on the axis of the spindle.

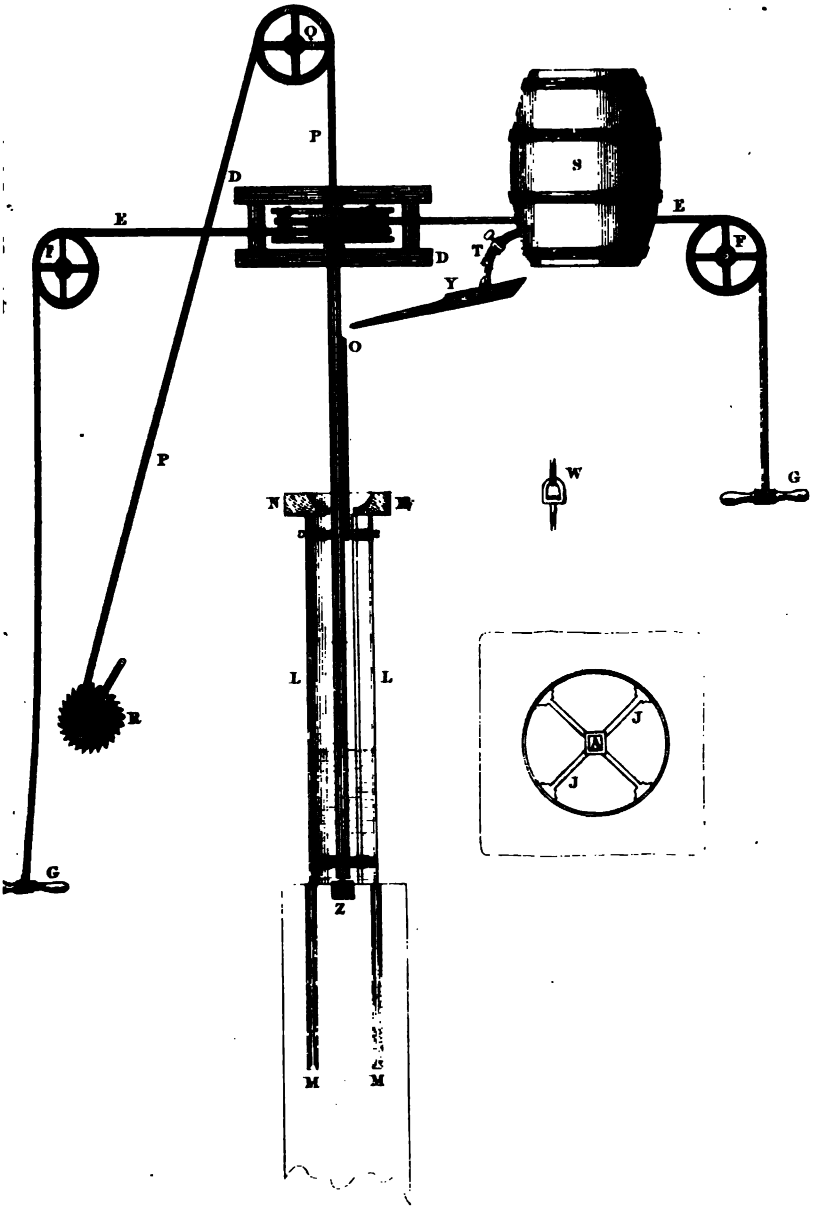
Seventh. At some convenient distance on one side I place a tub or cistern S, containing water, with its bottom as high as the pulley of the spindle. In the side of this cistern, near its bottom, I fix a cock T, by which a sufficient stream of water is discharged into a trough or conductor Y, placed gently sloping, whose other end reaches near to the axis or spindle; some sand being generally, from time to time, sprinkled into this trough or conductor, is by the water washed or carried down into the tube, and the tube being set in motion, the water and sand getting under the saw, which form its lower end, abrades or grinds away the stone, and forms a circular groove in it concentric with the axis of the spindle, and the tube being constantly pressed downwards, the groove becomes deeper, and the water accumulates in the inside of the tube until it can force its way under the saw, and escape by the outer side of the groove. In its passage it carries the sand along with it, which continues the action of the saw upon the stone; and when it has done its office it is carried away by the water, in the form of mud or sludge, so that the action is continued, without interruption, as long as the motion of the tube is maintained. Should that, however, cease for any considerable time, the sand will set fast round the tube, and it will be found difficult to free it again; therefore, when any accident or circumstance causes an interruption in the motion of the tube, it must be raised up by means of the small cord P P, which passes through the central perforation of the axis or spindle, and the windlass R, to which it is attached, at which time the water-cock may be stopped or not, as convenient; but if stopped the water-cock must be again opened, when the motion is recommenced, and the timber must be lowered till the saw reaches the bottom of the groove where it was before, and the process is continued, from time to time, until the saw and tube have passed quite through the stone, and the pipe, column, or disk, is formed as required.

N. B. By the means before described, the dead sand and sludge are removed as they are formed, and the necessity there would otherwise be of raising up the tube from time to time in order to take out the sand and sludge by some other means is avoided, and the operation

tion goes on without interruption. The maintaining always of a pillar of water, during the operation in the inside of the tube, sufficient to force its way under the lower edge of the tube and saw, and to carry the sand with it, forms, therefore, an essential principle of my invention; without this the tube would require to be frequently removed, and it would be almost impossible for the saw to penetrate beyond a few feet in depth in any reasonable time. When the depth of the bore or length of the pipe to be formed exceeds six or seven feet, I find it advantageous to make a readier outlet for the water, sand, and sludge, by boring a hole or holes, of an inch diameter, more or less, in the sides of the pipe, at such depth as may be found convenient; and when the pipe is finished I stop up the said hole or holes. When the apparatus is to be put in motion by a wind or water mill, by a steam-engine or horses, or by any other species of power than that of men, instead of the pulley C C I fix upon the socket B B a small toothed wheel or pinion which is acted upon by a reciprocating toothed wheel belonging to the mill, or by a reciprocating rack or sector put in motion by the same; or I retain the pulley and cord, as if it were to be acted upon by men, and I affix a sufficient weight or weights, or a spring, in place of one of the handles G, and cause the mill and its machinery to pull the other end of the rope by means of a crank, or other equivalent contrivance.

Eighth. When the outside of a pipe is to be rounded, I begin the operation by employing the tube L L, and saw, of sufficient diameter so as to leave the stone strong enough round the intended pipe, and proceed with them, as has been before described, until they have gone down through the whole depth of the stone, leaving within them a cylinder, of a proper size, for the intended pipe. I then remove the tube and its appurtenances, and put in their place a smaller tube, &c. of a proper size for the bore of the pipe, and proceed as before described. And if the bore of the pipe admits, by means of a still smaller tube and saw, I continue the operation so as to form as many pipes as the stone will admit. In some cases it is convenient to turn the tube and saw with a uniform rotative motion, always in one direction; but in such cases, as they make slower progress in doing the work, which is much accelerated by the reciprocating or alternate motion I give them in general, and in these cases, where an uniform relative motion is used, it will be found advisable to fix a swivel in the small cord P P, as that represented at W, to prevent its over twisting, and this again requires the pulley Q to be placed higher up, so as to give room to place the swivel between it and the pulley C C, to prevents its interfering with the swivel.

And be it remembered, that as cylindrical saws have been invented many years ago, and applied to and used for the boring of wooden pipes, I do not now claim any exclusive right to the use of such saws as so applied, and claim under this Patent only the particular application and construction of them hereinbefore described, especially the method of grinding the saw by means of the spindle passing through its axis, and the two crosses or wheels, one sliding upon the spindle and the other attached thereto, on which the tube can slide up and down. The working of the saw by a reciprocating or alternate motion instead of a rotative one, and the method of discharging the sand and sludge by a pillar of water, and in certain cases through a hole or holes in the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the sides of the pipe to be bored, all which I claim as new, and invented by me, as well as the general construction and manner of using the apparatus herein described, which I have set forth particularly, in order that my invention, and the manner of using and applying the same, may be completely disclosed and understood so as to be put in practice by others when my patent expires.

REFERENCE TO THE DRAWING. (Plate XVI.)

A A the axis or spindle. B B the hollow socket, fitted to its upper end. C C the pulley round which the rope that turns it goes. D D the frame in which the pulley turns. E E the rope or cord which turns the pulley and spindle. F F two pullies over which the rope passes. G G two handles fixed to the ends of the rope E E, by which the ends of it are pulled alternately. J J the lower wheel or cross, which is fixed or attached to the axis or spindle, and slides freely within the cylindrical tube. KK the upper wheel or cross, the rim of which is fixed or attached to the inside of the tube, and the centre hole of which is fitted to the spindle, on which it slides freely up and down, but cannot turn round upon it; but when the spindle turns round it causes this wheel or cross and tube to turn also. L L the cylindrical tube. M M section of the saw affixed to it. N N weights to load the tube, and cause the saw to act upon and penetrate the stone by the action of the water and sand. O the aperture of the perforation of the spindle. P P the small cord which raises the tube when required. Q a pulley over which it passes. R a windlass to which one end is attached. S a cistern or tub containing water. T the discharging cock. Y the sand trough or conductor. W a swivel, to be inserted in the cord P, when the tube and spindle are turned in one direction; and in this case the pulley Q is to be placed higher up. Z a plug, or step of wood, or metal, for the pivot of the axis of the spindle to move on: this is fixed in the stone to be bored.

In witness whereof, &c.

Specification of the Patent granted to James Parker, *of Northfleet, in the County of Kent, Gentleman; for a Cement or Terras to be used in aquatic and other Buildings, and Stucco-work.*

Dated June 28, 1796.—Term expired.

To all to whom these presents shall come, &c. Now know ye, that in compliance with the said proviso, I the said James Parker, in pursuance of, and compliance with, the said proviso in the said recited letters patent contained, do, by this present instrument, declare that the principle and nature of the said invention, and the manner in which the same is to be performed, is described and ascertained as follows; that is to say: The principle and nature of the said invention consists in reducing to powder certain stones or argillaceous productions, called nodules of clay, and using that powder with water, so as to form a mortar or cement stronger and harder than any mortar or cement now prepared by artificial means. I do not know of any precise general term for these nodules of clay, but I mean by them certain stones of clay, or concretions of clay, containing veins of calcareous matter, having frequently, but not always, water in the centre; the cavity of which is covered with small chrystals of the above calcareous matter, and the nodules agreeing very nearly in colour with the bed of clay in or near which they are found. These nodules, on being burnt with a heat stronger than that used for burning lime, generally assume a brown appearance, and are a little softened; and when so burnt and softened become warm (but do not slack) by having water thrown upon them, and on being reduced to powder, after burning and being mixed with water, just sufficient to make into a paste, become indurated in water in the space of an hour, or thereabouts. Any argillaceous stone, then corresponding with this description, whether known by the name of nodules of clay, or any other name, is the sort and kind only that I mean to appropriate to my own use in the formation of my cement. The manner in which I prepare and compose this cement is as follows; *viz.* The stones of clay, or nodules of clay, are first broken into small fragments; then burnt in a kiln or furnace, (as lime is commonly burnt,) with a heat nearly sufficient to vitrify them; then reduced to a powder by any mechanical or other operation, and the powder so obtained is the basis of the cement. To compose the cement in the best and most advantageous manner, I take two measures of water and five measures of the powder thus described; then I add the powder to the water or the water to the powder, taking care to stir and beat them during the whole time of intermixture. The cement is then made, and will set, or will become indurated in ten or twenty minutes after the operation has ceased, either in or out of water. But although I have described what I think the best proportions for the composition of the cement, it is expressly to be understood that these, and all other proportions, are to be included within the meaning and purpose of this specification, but that no other proportion will produce so strong a cement in so short a time as those I have here pointed out. And also, that I occasionally burn and grind and mix the powder before described with lime and other stones, clay, sand, or calcined earths, in such proportions as may be necessary and useful for the purposes for which the cement is intended to be applied, always observing that the less water is used the better, and the sooner the mortar or cement is used after being made, the stronger and the more durable it will be.

In witness whereof, &c.

Specification of the Patent granted to PETER STUART, *late of Fleet-street, in the City of London, Printer; for a Method of engraving and printing Maps of Countries, Charts, or other Plans or Designs, Music, Mathematical Diagrams or Figures, on Wood, Metal, or any other Substance, so that they may be thrown off in a common Printing Press or Presses, either for Books, Newspapers, or any other printed Paper whatever.*

Dated February 26, 1810.

TO all to whom these presents shall come, &c. NOW KNOW YE, that in compliance with the said proviso, I the said Peter Stuart do hereby declare that my said invention is particularly described and ascertained in manner following; that is to say:

My new method or invention is for the purpose of combining, in many instances hereafter specified, the arts of engraving and letter-press printing, so as to produce at once the dispatch and economy of the latter with the effect and general utility of the former.

My new method of printing maps, charts—geographical, astronomical diagrams, or mathematical figures—music—drawing books to teach outlines—architectural ground plans, plans or surveys of estates—trees, or tables of pedigree—anatomical figures, figures or representations of the human body—or, in short, any figure or figures *performed in my manner* about to be described or specified—for books, magazines, newspapers, or any other periodical publication, or for any printed paper whatever—consists, in the *first* place, in reversing the ordinary or common way of printing or representing such figure or figures; that is to say, where the usual mode of printing or engraving the figures now described has hitherto been by a black upon a white ground or surface, my new method is by producing the contrary effect, *viz.* by a white upon a black ground or surface. Again—in order that I may be fully understood—as the usual way of printing or representing in maps, for instance, the rivers, towns, fortifications, letters, or words, &c. &c. has been by black upon white, my new method is by producing a contrary effect, by leaving the tints, lines, or figures alluded to, white instead of black; so that where in the common way the paper is covered with black or coloured ink, my new method is to leave it uncovered; and where in the common way it is uncovered, by my method it is left covered. Farther—in order that I may be so understood as that any person conversant in the arts of printing and engraving may perfectly comprehend my meaning—my new method, instead of producing dark figures on a light ground, is by producing light figures on a dark ground or surface, or on a ground darker at least than the figures themselves.

Or my new method, in the *second* place, is by the usual way of representing all figures, that is, by the black tints or lines, or black figures as now commonly represented on a white ground or surface, or by the adoption of any other coloured ground or surface—taking care always to produce the advantageous combinations of the two arts of engraving and letter-press printing, that is to say, the dispatch and economy of the latter with the effect and general utility of the former—a combination hitherto wished for in vain, and from which, it may be obvious, very essential results will arise both to the artists and to traders in the arts, and, in fact, to the public, that will no doubt be actuated by interest to encourage a new invention which may afford an extraordinary gratification by a speedier mode of intelligence through a cheaper medium.

Having thus expressed myself fully on this part of the subject, I shall now proceed to describe or explain my mode of executing or producing the effects already specified:

The engravings of the figures may be cut or stamped, or otherwise indented, on plates of brass, copper, tin, pewter, type-metal, or any mixture of metals, wood, or any other substance on which engravings can be made; and, (in some instances), for the better adapting the ground or surface of the plate, or for the better rendering the ground or surface fit in all its parts for the proper reception and adhesion of that kind of ink used by letter-press printers, so as to produce a clear and an equal impression on all its parts at once—an invention on metallic plates hitherto, I verily believe, unattempted, or at least unattained—I cause dots or lines to be cut, marked, or stamped, or drawn across the ground or surface of the metallic plates, or other substance; or I corrode it with aquafortis, vitriol, or other acid, so as to produce a sufficient degree of roughness for the adhesion of the particular ink now mentioned; leaving the figures or subject of the plate or plates, or engraving, untouched by such dots or lines. I wish also particularly to observe, that it is absolutely necessary the lines cut, stamped, or engraved, should be as deep as possible, or as deep as the ultimate operation of the press may require—a mode unnecessary in the common way of copper-plate engraving; and that the part of the surface which is not engraved upon, instead of being made as smooth as possible, as in copper-plate engravings, ought to be made, (in some instances) as before specified, sufficiently rough, either by mechanical or chemical means so as to make the ink applied by the letter-press printer's balls adhere in a way nearly equal, or in such quantity or proportion as is wanted or intended.—The last preparatory process of the plate for the letter-press, previously to its being printed as described, is by fixing it on a wooden block; or by grooving it on a brass or other metallic standard; or by fixing it on a clay or earthen substance or cement—taking special care that the whole body thus formed shall not be higher or lower than the types commonly used at the letter-press; and also taking special care, that it be calculated in every degree to be embodied as it were with the letter-press printer's form or types, so as to produce, by the very same operation of the letter-press, the impression of both the plate and the types at one and the same time, or by one and the same pull of the letter-press printer, and on the very same sheet or piece of paper.—Or the plate or plates thus prepared, may, if on particular occasions deemed more expedient, be worked off alone at the letter-press, so as to produce the intended effect of engraving with the facility and dispatch of multiplying copies agreeably to the nature or principle of operation peculiar to the letter-press. I wish also to be clearly understood, that the plate or plates for maps, charts, music, or other figures already mentioned, may be prepared by engraving, indenting, or stamping, on a flat surface of wood, of metal, or other material or substance, so as to form a matrix or mould from which I cast or form the reverse, in the manner of a seal or die, that is to say, the hollows, or sunk lines, dots, letters or figures of the former, become the protuberances or raised lines, dots, &c. of the latter, by which I print by the common process of the letter-press printer.

Thus by the means now described or specified, I combine, or unite, for maps, charts, music, anatomical figures, or any figures or representations of the human body, or for all or any of the other figures already mentioned, performed in my manner, the separate arts of the copper-plate engraver and the letter-press printer, by engraving as engravers usually do, and by printing as printers usually do—thereby rendering, by the application of these united arts in the printing of books, magazines, newspapers, periodical publications (which require dispatch), a very great saving or abridgment of time, labour, and expense, in the exercise of both arts, and consequently a very great convenience and advantage to the public at large."

In witness whereof, &c.

A Detail

A Detail of Experiments to ascertain the daily Quantity of Brown Muscovado Sugar necessary to fatten Sheep; to shew its Effects and Value when so applied; and to demonstrate what Substance or Substances, sufficiently cheap, might be mixed with it, so as to prevent its Application to common Uses, and yet render it not unpalatable nor pernicious to Animals which feed upon it.

By the Rev. Dr. CARTWRIGHT.

(Concluded from Page 292.)

HAVING, as I apprehend, brought this part of my experiment to a satisfactory conclusion, I shall just observe, that in all the different trials with the deteriorated substances which have been here enumerated, it was an act rather of epicurism than of hunger, in the sheep to feed upon the sugar in which these substances were mixed; for the sheep, during the early period of my experiments, lay in a very good pasture, and were not folded, nor were they kept fasting longer than about a couple of hours before their artificial food was given to them. This short interval of abstinence I thought indispensably necessary, as it appeared to me not improbable that, if their artificial food were given to them immediately on their being taken into the fold, they might have rejected, or have been indifferent to it from mere repletion; and consequently very unsatisfactory, if not erroneous, conclusions might have been drawn from a circumstance so unguarded, and a trial so imperfect.

From what opportunity I have had of observing, sugar seems to be so particularly grateful, not only to sheep, but to domesticated animals of every description, that

I should doubt whether any thing, how nauseous so ever it might be, if given in moderation, would make them abstain from it, or at least from being soon reconciled to its adulteration *. Indeed, the rank smell and flavour of coarse Muscovado sugar, such as that which I made use of, are of so predominating a nature as effectually to disguise the smell and flavour of most other substances which might, in small quantities, be mixed with it.

It will be noticed, that I have made no experiments with salt. Indeed, I considered any experiments that could be made with a substance universally known to be grateful and salubrious to cattle of every description, as perfectly unnecessary. I had, however, another reason for not giving it a trial, which was this: salt, without some other addition, would not render sugar unfit for a very important process in domestic economy, that of curing meat. And here I may be permitted to observe, though the observation is certainly foreign to the subject under consideration, any farther than as it respects the interests of the West India planters, that a copious use of sugar, either wholly † or in part, in cur-

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* It may be satisfactory to the Board of Agriculture to be informed, that every one of the contaminating substances which I have made trial of with my sheep, has been given, with equal success, to a horse. The only substance at which the animal hesitated was assafœtida, and that only the first time it was administered. Both sheep and horses are known to be delicate-feeding animals, compared with cattle. What sheep and horses will eat it is not to be supposed, therefore, that cattle will reject. The horse's allowance was two pounds of sugar in a bushel of bran *per* week, which maintained it, as nearly as I could calculate, in the same condition as half a peck of oats *per* day.

† To preserve meat wholly by the means of a saccharine substance is not a modern discovery. Apicius, who wrote de Arte

Coquinaria

ing ship's provisions, would render them more palatable and more wholesome, and would no doubt operate most powerfully as a preservative against the sea-scurvy. For a purpose like this, a remission of the duty would be an act not only of humanity, but of sound and liberal policy; for though there would certainly be a considerable defalcation (supposing this suggestion to be acted upon) from the duty on salt, in a proportionate ratio to the quantity of sugar which might be substituted in its place; yet this, surely, would be a consideration which, it is presumed, would not be suffered to come in competition with the reasonable gratification and health of such a valuable class of men as the British sailors, the great pillars of our national prosperity, which they equally sustain, whether employed in the royal navy for the nation's defence, or on board of merchant-men for the extension of its commerce. Oil of vitriol has been mentioned as a substance which would render sugar unfit for domestic purposes. Conceiving this to be a mistake, I

Coquinaria in the time of Trajan, in giving directions how to keep meat fresh for any length of time without salt, expressly says, *carnes recentes quales volueris* mello *tegantur, sed vas pendeat et, quando volueris, utere, &c. Vas pendeat* I suspect to be a false reading, though his German commentator, Humelbergius, or Humburgius, (quoting from memory I am not quite certain of the name) seems to think not. I have no doubt, however, that any other Humburgius, (our celebrated Apician high priest of luxury, for instance, in the Strand), will agree with me that we ought to read, instead of *vas pendeat, in vase pendeat;* that is, let the meat be suspended, not lie, in the vessel, and for this obvious reason: if the meat were not suspended, certain parts of it must of necessity come in contact with the bottom of the vessel, and probably with the sides of it, in which case the honey (which we are to presume must be fluid when first used) would from those parts of course be excluded, and the meat, wherever it touched the vessel, be liable to putrefy.

did not try it. The vinegar-merchant best knows whether oil of vitriol, being mixed with sugar, would prevent him from using it in his manufactory.

There are several other substances, I understand, which, mixed with sugar, will render it unfit for common purposes, such as alkaline salts of all kinds. But as these, besides being too expensive, entirely destroy the saccharine taste and flavour, I thought it to no purpose to try them. In the first place, by rendering sugar no longer sweet, it is very possible that cattle would with difficulty, and by compulsion only, be induced to eat it. In the next place, the sugar in this state would most probably be less nutritious, as there is reason to suppose that it would be brought back but imperfectly by the action of the stomach into its original state, which state it would be necessary it should be brought into before it could constitute the saccharine part of the chyle, or assist in developing the saccharine matter from the rest of the food. Supposing, which is not impossible to be the case, that the action of the stomach should have no such effect, or at least but in an imperfect degree, its value would then be no more than so much mucilage, which would bear a very inconsiderable proportion to its value as sugar.

Of the substances which I tried, there can be no doubt of most of the oleaginous ones being eminently nutritive; but as I had some doubts that to give them in sufficient quantities to be of any benefit in fattening cattle of any kind might not answer the expense, I deemed it highly unnecessary to proceed farther in my experiments with them, than merely to ascertain the fact, that cattle would not reject them, mixed in such proportions with the sugar as would render it unfit for all the pur-

poses to which sugar has hitherto been usually ap-
ed.

To have tried, to ascertain the nutritious effects of
fœtida, urine, or antimony, in its different forms,
ld have been a ridiculous waste of time. It is suffi-
t to be convinced that the small proportions of these
les, necessary to debase the sugar, which cattle
freely take, may be taken by them, if not with any
eptible advantage, at least without injury. But
ng some reason to believe that charcoal, as supply-
the carbonic principle, might be given in consider-
quantities, and with a perceptibly beneficial effect,
ided my flock into three classes, five in each class.
the first I gave bran, peas, sugar, and charcoal;
part charcoal to two of sugar. To the second bran,
, and sugar, deteriorated with the composition I
already recommended. To the third bran and peas
. By this arrangement a comparison of the first and
nd classes with the third would shew the effect and
e of sugar in feeding and fattening sheep: by the
and second classes might be ascertained the quanti-
of brown Muscovado sugar which could be given to
p without palling the appetite, or disordering the
els; and by weighing the sheep in different stages
e experiment, and then increasing the proportion of
r, a maximum might possibly be discovered, which
d regulate the quantity of sugar to be given in fu-
with the most economical advantage. For though
not unreasonable to suppose that the maximum will
etermined by the quantity of sugar that can be taken,
out palling the appetite or disordering the bowels,
it is not impossible that, when the assimulating
rs of the stomach are supplied with such a quantity
of

of saccharine matter as may be sufficient to give the requisite sweetness to the chyle, any farther supply, though it might not, perhaps, sensibly affect either the appetite or the bowels, would not turn to a profitable account. By comparing the first and second classes together, it would then be seen whether I was right in my conjecture of the benefit to be expected from a copious use of charcoal.

It may not, perhaps, be improper in this place to notice, that whatever is the predominant flavour of the principal substance on which an animal feeds, that flavour may generally be perceived in the flesh or milk of the animal so fed. The effect of cabbage or turnips on cow-milk is well known. The milk of cows, pastured in fields where the wild garlick abounds, will not only have a smell and taste highly pernicious, but even a diuretic quality.

Birds of the aquatic kind, such as feed upon fish or their spawn, have invariably in a greater or less degree a fishy taste. Mutton, of sheep fed on cole or turnips, if not fasted for at least eight and forty hours, or if their food is not changed for the same space of time previous to their being slaughtered, will betray by its flavour a certain indication of the vegetables which the sheep have been fed upon. These facts may be thought to militate against the use of most of the above-mentioned substances, for rendering sugar unfit for common purposes. But it can hardly be supposed that given in the small proportions here recommended, (not more than a dram *per* day of some, of others not more than a few grains,) the flavour would be perceived in the flesh. Should experience, however, contradict this supposition, the remedy is easy: let the use of the sugar, and its

contaminating accompaniments, be suspended only for a
'ew days before the animal is consigned to the butcher,
nd the flavour of the offensive ingredient will no longer
redominate or be distinguished. Previous to entering
nto a detail of this final set of experiments, it must be
bserved, that I made no use, in any part of the process,
f cut straw or chaff, which I considered of very little
alue as food. When animals, particularly horses, are
isposed to swallow their corn whole, cut straw compels
em to masticate it: given with that intention it is of
reat use; but to make it the vehicle of such an article
sugar would be to proceed upon the supposition, that
gar acts on the animal constitution merely by the bulk
nutriment which it contains. Were this the case, the
ost that could be expected from a given weight of
gar would be a corresponding increase of weight in
e animal which it was given to. But this, we may
ppose, would be nearly impossible, as a certain por-
on of it might be expected to be carried off in the
ces. The fact is, that sugar, when received into the
imal-stomach, has the property of developing the sac-
arine matter contained in the rest of the food it there
eets with, and of converting it into chyle. Hence a
ngle ounce of sugar, by separating the saccharine mat-
r from substances which would otherwise in part go off
y the intestines, may be the means of adding several
nces of flesh to the animals that are fed upon it. That
gar operates in some such manner as this we have
ery reason to conclude, by analogy, from a well-known
ct in the process of distillation. The vinous fermenta-
on never takes place in wash obtained from raw grain;
t if with the raw grain is mixed malted grain in cer-
in proportions, and the mixture is then mashed, the
saccharine

saccharine matter, which is already developed in the malted grain, assists in setting at liberty the saccharine matter, or a part of it at least, which lay dormant in the raw grain, and the whole enters into a state of fermentation. Hence may be inferred the propriety of mixing sugar principally with those kinds of food which are capable of giving out the greatest quantity of saccharine matter. There is, however, a maximum in this, as in most other things, which it would not be good economy to exceed. Of this we may be nearly certain, that were an animal to be fed solely on corn and sugar, and when he had eaten as much as was necessary for his nourishment he were to eat no more, the bowels, for want of their due distension, could not act upon their contents, so as effectually to squeeze out and separate the chyle to be absorbed by the lacteals.

On the other hand, if, after the animal had taken food sufficient for his nourishment, he were to continue to eat on the same expensive food, which he would do if it were given him, till his bowels had acquired their due distension, the expense of such diet would probably go near to counterbalance the profit; as a considerable part of it would unavoidably pass through him, carrying along with it a certain share of its nutritive particles; which, indeed, is always the case in a greater or less degree, especially when an animal is fed with a view to his being made fat. This accounts for the manure of high-fed animals being so much richer than of animals kept upon ordinary food in a store state; for all that part of their food which is not converted into nutriment by the digestive and assimilating powers of the stomach, or impelled into the lacteals by the action of the intestines, must of course form the excrements, which of necessity will be of a more or less fertilising quality, as they are more or less charged with those particles of matter, which are well known by experience to afford nutriment, equally to the vegetable as to the animal kingdom. Though I cannot but condemn the practice of making cut straw, or chaff, the sole vehicle of sugar, yet, for obvious reasons, I should recommend a certain quantity to be given along with oil-cake, corn, or other nutritive food with which the sugar might be mixed, merely for the purpose of distending the bowels, without which distension the bowels would but imperfectly perform their functions.

On the 22d of October the sheep were taken into the house, and kept upon artificial food altogether, being first weighed. Their respective weights and increase will appear by the following table.

	Weights Oct. 22d.	Increase since Sept. 24.	Increase since Aug. 27.
No. 1	133	13	33
2	141	21	46
3	118	14	34
4	125	11	31
5	110	16	32
6	127	17	35
7	121	17	31
8	120	10	33
9	115	13	28
10	135	21	38
11	120	14	32
12	125	13	31
13	113	14	29
14	116	16	31
15	138	16	38

The day after they were weighed, one of them being observed to droop, it was thought expedient to have it slaughtered, that what were left might admit of an equal division in point of number, two others were at the same time consigned to the butcher. These three, thus disposed of were No. 5, 13, 14.

The twelve remaining were then divided as follows:

1	133	2	141	6	127
3	118	4	125	7	121
10	135	9	115	8	120
11	120	12	125	15	138
	506		506		506

Previous to the commencement of the experiments which were now going to take place, the sheep had no sugar in their food for some days; till such time, in short, as I perceived that they were reconciled to its omission. This I did that they might all start fair; for, otherwise, those from whom the sugar was to be withdrawn would at first, as might reasonably be expected, have experienced a check, which would give an unfair advantage to the sugar-fed ones with which they were to be compared.

On the 12th of November (ten days after the final arrangement was made, and twenty-one days since they were weighed before) the sheep were again weighed; their respective weights were as follow:

1st Class.

	1st Class.		2d Class.		3d Class.	
	1	135	2	145	6	132
	3	123	4	130	7	123
	10	138	9	121	8	124
	11	122	12	130	15	142
		518		526		521
		506		506		506
Gained		12		20		15

Their gain, it will be perceived, was inconsiderable; but, it is to be observed, that they were scarcely as yet reconciled to their confinement. Indeed, it has always appeared to me (and I have had frequent opportunities of making the observation) that no animals submit with greater reluctance to close confinement than sheep, especially those which have been used to an extensive range, such as the native South-downs. And this impatience of restraint, as it originates in timidity, is more difficult to subdue than if it were from most other causes. Confinement not only alarms their fears, which alone would impede their thriving, but, as I apprehend, has an influence on their bodily temperament by no means congenial with their natural habits.

It will be observed, that the sheep which had charcoal in their food made the least progress. Unfortunately I had it not in my power to give this experiment a fair trial. For not having the convenience, nor the means of getting the charcoal more than partially pounded, I was under the necessity of giving some of it in a very coarse powder. For the first three or four days, while the finest part of the powder lasted, the sheep fed very heartily; but afterwards, when they came to the coarser parts, and found it gritty between their teeth, they revolted at it more than at any thing I had yet tried them with: so much so, indeed, as not to eat nearly the quantity of food they ought to have done. Considering, therefore, the difficulties I had to contend with, and the uncertainty of my remaining for any length of time, which was necessary for giving the experiment a fair trial, in my present situation at Little Hampton, I gave up this part of my experiment; which I did with the more reluctance as, from the experience I have had in mixing charcoal with the food of poultry, I have formed, and I have reason to think on good grounds, a very favourable opinion of it.

From the 12th of November till the 19th I gave to the first class six ounces of sugar *per* day to each sheep, omitting the charcoal; to the second class, four ounces; to the third none. The food consumed by the three classes was as follows:

	1st Class.			2d Class.			3d Class.		
	B.	P.	Q.						
Bran	1	0	1½	1	1	5	1	1	2½
Peas	0	2	0¼	0	2	6½	0	2	5½
Sugar	0	10½ lb.		0	7	0	none.		
Hay	0	21 lb.		0	21	0	21 lb.		

Their weights on the same day were as under.

1st Class.		2d Class.		3d Class.	
1	136	2	146	6	133
3	121	4	131	7	124
10	140	9	123	8	125
11	123	12	131	15	141
	520		531		523
	518		526		521
Gained	2		5		2

On the 26th of the same month they were again weighed.

1st Class.		2d Class.		3d Class.	
1	135	2	147	6	135
3	122	4	134	7	124
10	141	9	126	8	126
11	122	12	134	15	142
	520		541		527
	520		531		523
Gained....	000		10		4

The consumption of food was in this week as follows:

	1st Class.			2d Class.			3d Class.		
	B.	P.	Q.	B.	P.	Q.	B.	P.	Q.
Bran	0	3	7	1	3	4	1	1	4
Peas	0	1	7½	0	3	6	0	2	6
Sugar........	0	10½ lb.		0	7 lb.		none.		
Hay	0	21 lb.			21 lb.		0	21 lb.	

It will be observed that the class to which I had given the six ounces of sugar *per* day each have in the last fortnight gained only two pounds, and that gain was made in the first week. During this period, except for the first two or three days, they did not feed (as will appear by their consumption of food) nearly so well as the rest. This I can account for no other way, than by supposing that the superabundant quantity of sugar palled their appetites. It had, however, scarcely any perceptible effect on their bowels, at least not any effect that could indicate its disagreement with them.

Being now fully satisfied that I had exceeded the maximum of sugar that can be given to sheep, with a reasonable prospect of a beneficial effect, from this day, namely the twenty-sixth of November, I gave sugar in the same proportions to each of the two first classes, that is to say, four ounces to each individual sheep.

On the 3d of December they were again weighed.

1st Class.		2d Class.		3d Class.	
1	140	2	150	6	137
3	124	4	136	7	125
10	143	9	129	8	129
11	126	12	138	15	144
	533		553		535
	520		541		527
Gained	13		12		8

The consumption of food during this week was by the

	1st Class.			2d Class.			3d Class.		
	B.	P.	Q.	B.	P.	Q.	B.	P.	Q.
Bran	1	1	6	1	1	6	1	1	4
Peas	0	2	7	0	2	7	0	2	6
Sugar	0	7 lb.		0	7 lb.		none.		
Hay	0	21 lb.		0	21 lb.		0	21 lb.	

N. B. The hay was not weighed out severally to each class, but given to them in as equal proportions as could be adjusted by the eye. A truss, weighing 56 lb. lasted them six days, which brings the quantity consumed by each class to what I have stated it within a small fraction. But, as it was observed, that, whether they ate more or less of their other food, the hay was always eaten up clean, from the third of December their allowance of it was increased, as nearly as could be judged by the eye, to four pounds daily to each class.

It will be remarked, that between the twelfth of November (at which time we are to suppose the weights of each class corresponded) and the third of December, the space of twenty-one days, the third class from whom the sugar had been withdrawn had fallen short of the cond class, which had uniformly been supplied with eighteen pounds.

I am justified in attributing this gain of flesh solely the sugar, because when the sugar was again given to e class from which it had been withdrawn, that class ually took the lead.

These eighteen pounds of flesh, which the sugar-fed ep gained over those which had none, were pursed, it will be observed, at the expense of twenty-e pounds of sugar, which at four-pence *per* pound r at such price I presume it may be afforded duty e) would amount to seven shillings, not half the value he 18 lb. of flesh *. But the profit in this case is not fined merely to the balance between the sugar exded and the flesh gained; the saving of time (the st important of all savings in this, as in most other es, if rightly understood) and the consequent saving ther food, besides the increased value of the manure, all to be taken into the calculation.

now considered it no longer necessary to continue experiment which appeared to be sufficiently decided, l therefore I gave sugar alike to all the three classes.

)n the tenth their weights were as under :

1st Class.		2d Class.		3d Class.	
1	142	2	151	6	138
3	125	4	136	7	127
10	147	9	130	8	131
11	126	12	138	15	146
	540		555		542
	533		553		535
	7		2		7

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* The carcases of these sheep were sold for 7s. per stone.

During this week it will appear that their general improvement, though not absolutely stationary, had fallen much short of what it had been in the preceding week; and yet the quantity of food consumed by them in that space of time had been more than equal to the consumption of the former week, as will appear by the following table.

	1st Class.			2d Class.			3d Class.		
	B.	P.	Q.	B.	P.	Q.	B.	P.	Q.
Bran	1	1	7	1	1	6	1	1	7
Peas	0	2	7½	0	2	7	0	2	7½
Sugar	0	7 lb.		0	7 lb.		0	7 lb.	
Hay	0	28 lb.		0	28 lb.		0	28 lb.	

I am totally at a loss to account for the cause of so material a variation from their usual rate of improvement, unless it could be owing, which appears to be impossible, to their having been turned out every day this last week for two or three hours at noon; from which, indeed, I had expected a totally different result. For it was surely not unreasonable to conclude, that animals, whose natural habits revolt at confinement, and which had been cooped up for weeks in a close stable, would have felt the exhilarating effects of being indulged with the liberty of breathing a free air, and would have been benefited by the indulgence. It is more than probably, however, that some other cause, unconnected with this circumstance, and which had eluded my observation, might have had its operation in producing a result so contrary to what I had looked for. I recollect, in an experiment on a number of stall-fed sheep which I formerly conducted under the direction of the late Duke of Bedford, that in some weeks their gain of weight was comparatively little, in others very considerable.

Though I will remember paying the most minute attention to the subject, I was never able to discover whence a fluctuation apparently so anomalous could arise.

The next day of weighing was the seventeenth.

1st Class.		2d Class.		3d Class.	
		2	156	6	138
3	128	4	138	7	131
10	149	9	131	8	134
11	126	12	143	15	151
	403		568		554
	398		555		542
	5		13		12

The progress of improvement has this week been reasonably uniform. One circumstance is remarkable: the second class, which in the last week gained only two pounds, has in this gained more than six times that weight, though the consumption of food by this, as by the other two classes, has been exactly the same (deducting for number one of the first class which was slaughtered on the tenth) as of the preceding week: here then is another fact to be added to the many which any man's experience will furnish him with, who has repeatedly and accurately attended with the weights and scales in his hand (and there is no other way of judging decidedly) to the progress of improvement which animals, especially if stall-fed, make in a fatting state. I particularly wish to direct the attention of the experimental cattle feeder to this subject. It is pregnant with much important matter: if once the causes of the irregularities, which will be found recorded in this paper,

and

and which are to be found in every faithful detail of experiments of the like kind, can be fairly accounted for, we may then hope to arrive at the knowledge of certain indubitable and fixed principles, which shall direct and guide us to the object we have in view, without the fear of deviation or disappointment.

The last time that the sheep were weighed was on the twenty-fourth.

1st Class.		2d Class.		3d Class.	
		2	155	6	140
3	132	4	139	7	132
10	149	9	133	8	135
11	128	12	143	15	153
	409		570		560
	403		555		554
	6		15		6

The gain of weight of the whole flock has this week fallen short of the last, by more than one half, without any apparent cause for such a failure, their consumption of food being the same as it had been for each of the two preceding weeks.

Though the mode I adopted of keeping the sheep confined, and weighing and measuring out their food to them, was the only method of ascertaining, as far as could be ascertained, the effects of the regimen I had put them upon, I had not the remotest idea of making the experiment profitable to myself, or of holding out an inducement to any one else to treat sheep precisely in the same way, unless for the purpose of establishing some fact like the one I have been in pursuit of, which could no otherwise be ascertained. Supposing that I had nothing more in view than to have made the greatest profit of my sheep, I probably might have followed a somewhat different course with them, provided my present situation would have admitted of it. But then the facts which I wanted to establish could not have been so clearly proved as, I am willing to hope, they now in some degree are. These facts, however, being once in his possession, the experienced farmer need not be instructed how best to turn the knowledge of them to his advantage. Circumstanced, indeed, as I was, being only a temporary resident in lodgings, and of course having no land in my own occupation, I was under the necessity of accommodating myself to the peculiarities of my situation in the best manner I could. The only place I was able to procure, in which to confine my sheep and try my experiments, was a very small three-stall-stable. And yet, considering the disadvantages which I laboured under, I flatter myself that I have arrived at the conclusions which I have drawn from these experiments not unsatisfactorily, though certainly not at so cheap a rate as might have been wished. No farmer will ever think of fattening sheep altogether upon sugar and artificial dry food. Sugar is an article which he will brobably fly to chiefly in winter and spring, when there is a scarcity of other food, to make that other food go as far as he can. There is reason to think, that it will be found an excellent practice to give sugar (provided a drawback of the duty be allowed) with bran, ground corn, or oil cake, as the vehicle to fatten sheep during the winter and spring months while at grass or turnips. For ewes, fattening their lambs, sugar must be a most admirable food, and will probably make greater returns this way than in any other, as it will contribute to bring the lambs forward to an early market, which, in the sale of fat lambs, is of infinitely greater importance than in the sale of any other stock whatsoever.

For sheep also, which are suspected of being tainted with the rot, sugar would be very useful. It is not improbable that substances might be mixed with it which, if they did not cure, might at least arrest the progress of the disorder. But admitting that they had no such beneficial effects, sugar would contribute so greatly to the sheep's expeditious fattening as to make them in many cases ready for the butcher before the disease could have time to make a destructive progress, or its ravages interrupt the sheep's propensity to get fat under such a forcing regimen.

It may seem scarcely necessary to notice, that the benefit to be expected from the fattening sheep with sugar is not confined merely to the profit upon the sheep themselves; the land on which they are fattened will be benefited in proportion to the increase of stock which may thus be kept upon it, and the superior richness of the manure which such stock so maintained will produce.

Should the foregoing experiments be considered as not absolutely decisive, yet their results, it is presumed, will be found of some importance; by any one, who will be at the trouble of minutely examining the tables, and comparing together the progress of improvement of any one individual sheep with another, it will be seen how difficult it is to draw conclusions which shall do more than barely approximate to the truth. It is to be observed, what indeed is well known to the physiologist, or any one who is conversant with the nature of living animals, that though there are certain general laws by which the animal economy is sustained and governed, yet that every individual animal has a peculiarity of constitution, an idiocrasy as it is called, receiving its modification from causes which in most cases baffle our research, and which, in consequence of such modification, is subject to great irregularities. Hence arises that disparity of effects from the application of apparently the same causes. Were this not to be the case, the same quantity of food, with the same treatment, would invariably produce the same increase of flesh in one animal as in another.

But though the disparity is apparent in a solitary comparison of one individual with another, it in a great measure disappears when numbers are taken collectively. When, therefore, we find that the average of these solitary comparisons preponderates to establish any particular fact, we may be certain that the conclusions we draw from it are, in most cases, not far from the truth. On this ground, therefore, it is presumed that the following conclusions, drawn from the facts which I have now the honour to lay before the Board, may be justified.

First. That sugar may be given with great advantage to sheep, if not confined; especially if they have access to green food, however little that green food may be in quantity.

Secondly, That sugar may be given to them with every prospect of a beneficial effect, in the quantity of four ounces *per* day to each sheep.

Thirdly. That sugar, supposing it to be purchased at four pence *per* pound, (which it might be if duty free,) would, at the rate of four ounces *per* day, be paid for in a return of flesh, exclusive of the advantage of expeditious feeding, and the benefit to be derived from the manure.

Fourthly. That six ounces *per* day to each sheep exceeds the maximum that can be given with the best advantage: (this, it is obvious, applies to the middle-sized sheep only, such as those on which I tried the experiment. It is probable that six ounces might not be too much for some of the larger breed of sheep, as four ounces might be greatly too much for some of the diminutive breeds).

Fifthly. That the advantage of stall-feeding sheep altogether upon sugar and dry food, of whatever nature that food may be, is extremely problematical.

Thus have I candidly laid before the Board the result of a long series of experiments which, it will be perceived, have been prosecuted with unremitted attention and, in consequence of my being particularly circumstanced, at no inconsiderable expense and trouble for the space of four months and upwards.

Should any gentleman be disposed to repeat these experiments, having within himself * all the requisite conveniences for such an undertaking, I cannot but persuade myself, though he will certainly attain his object more cheaply and readily than I have done; that his conclusions will confirm the general accuracy of mine.

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* It requires no great forcsight to predict that there will be great disagreements in the reports which may be made of experiments with unadulterated sugar in feeding cattle. The temptation of appropriating the sugar in a greater or less degree to his own use is so great, as to put the honesty of the person who is to administer it to a severe trial. It is but justice to say of the servant whom I employed in this business, that I have the fullest confidence of my directions, in all those instances in which I could not see to their execution myself, being attended to with the most scrupulous fidelity.

Observations

Observations upon Luminous Animals.

By J. MACARTNEY, Esq.

(Concluded from Page 311.)

circumstance of there being points, which give
permanent light than the other parts of the lu-
rings of the abdomen, has been noticed before
Comte G. de Razoumouski. He states the num-
hese luminous points to vary from 2 to 5 *.
st however remark, that I never saw more than
these luminous points, which were always upon
ring of the body, and that the figures which ac-
y the memoir of the Comte de Razoumouski,
arcely any resemblance to the insect they are in-
to represent, from which we may fairly suspect
inaccuracy in other particulars.

r as my observation has extended, the small sacs
inous substances are not found in any species of
is, except the glow worm of this country. Thun-
entions that the lampyris japonica has two vesi-
the tail, which afford light.

organs for the production of light in the genus
are situated in the corcelet; these likewise consist
culiar yellow substance, placed behind transparent
f the shell, which suffer the natural colour of this
ce to be seen through them in the day, and when
ated, give passage to the light.

issecting the organs of light in the elater nocti-
I found that there is a soft yellow substance, of
l figure, lodged in the concavity of the yellow

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* Mem. de la Soc. de Lausanne, Tom. ii.

spots of the corcelet, which parts are particularly thin and transparent in this species. This substance is so remarkably close in its structure, that at first view it appears like an inorganic mass, but with a lens, it is readily perceived to be composed of a great number of very minute parts or globules closely pressed together. Around these oval masses, the interstitial substance of the corcelet is arranged in a radiated manner, and the portion of the shell that immediately covers the irradiated substance, is in a certain degree transparent, but less so than that which lies over the oval masses, it is therefore probable, that the interstitial substance in this situation, may be endowed with the property of shining. A fasciculous of the muscles of the corcelet arises in the interior of the oval masses of the luminous substance, but not apparently with any design, as it contributes, with the adjacent fasciculi, to move the anterior feet.

In the elater ignitus, the masses of luminous substance are extremely irregular in their figure: they are situated nearly at the posterior angles of the corcelet, and are more loose in their texture than the oval masses of the noctilucus, resembling rather in composition, the interstitial substance which surrounds these masses in that species. The shell of the corcelet is somewhat thinner, and more transparent along both sides of the margin, than at other places, but it is not, as in the noctilucus, elevated, and peculiarly clear and thin immediately over the seat of the luminous organ; consequently, the light emitted by the elater ignitus, cannot be very brilliant.

I have not been able to procure any specimen of the elater phosphorea, but from the accounts of naturalists, it appears to resemble in every respect the elater noctilucus;

lucus; indeed I have great doubts of the phosphorea being a distinct species.

I have had an opportunity of examining, preserved in a moist way, two species of fulgora, the candelaria and lanternaria. The light in this genus has been observed to issue from the remarkable proboscis on the fore part of the head. This part has always been described by authors, as hollow or empty, which I have found to be perfectly correct; and what is more extraordinary, that the cavity communicates freely with the external air, by means of a chink or narrow aperture, placed on each side of the root of the proboscis. This projection is covered internally by a membrane, between which and the horny part or shell, there appears to be interposed a pale reddish-coloured soft substance, that is arranged in the candelaria in broad lines or stripes; but it is so thin, that I could not distinctly examine its structure, or absolutely determine, whether it should be considered as a substance intended to furnish the light of these insects, or the pigment upon which the colour of the proboscis depends.

The globes of the antennæ constitute the organs of light in the pausus spherocerus. Dr. Afzelius, who discovered the luminous property in this species, compares them to lanterns spreading a dim phosphoric light *. The rarity of the insect put it out of my power to examine its structure, but from the form and situation of its organs of light, it is most probable they are constructed like those of the fulgoræ.

It has been conjectured by Carradori and others, that the lampyrides were enabled to moderate or extinguish their light, by retracting the luminous substance under a mem-

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* Lin. Trans. Vol. IV.

a membrane; but neither in them, or any of the other luminous insects, have I found an apparatus of this sort. The substance furnishing the light, is uniformly applied to corresponding transparent parts of the shell of the insect, from whence it is not moved; indeed a membrane, if it did exist, would have but little effect in obscuring the light, and never could serve to extinguish it. The regulation of the kind and degree of the luminous appearance, does not depend upon any visible mechanism; but like the production of the light itself, is accomplished by some inscrutable change in the luminous matter, which in some animals is a simple operation of organic life, and in others is subject to the will.

It is worthy of remark, that in all the dissections I have made of luminous insects, I did not find that the organs of light were better, or differently supplied with either nerves or air tubes, than the other parts of the body. The power of emitting light likewise exists in many creatures which want nerves, a circumstance strongly marking a difference between animal light and animal electricity.

With the exception of the animals above mentioned, the exhibition of light depends upon the presence of a fluid matter.

In the pholas dactylus, the luminous fluid is particularly evident, and in vast quantity; it is recorded by Pliny, that this fluid is like liquid phosphorus, and renders every object luminous with which it comes into contact. Reaumur also found that it was diffusible in water, or any other fluid in which the animal might be immersed *.

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* Mem. de l'Acad. des Sc. 1712.

The shining of the scolopendra electrica, I have always observed to be accompanied by the appearance of an effusion of a luminous fluid upon the surface of the animal, more particularly about the head, which may be received upon the hand, or other bodies brought into contact with the insect at the moment, and these exhibit a phosphoric light for a few seconds afterwards. This fluid, however, I never could discover in the form of moisture, even upon the clearest glass, although examined immediately with the most scrupulous attention by a lens; it must therefore be extremely attenuated.

The same appearance has been observed during the illumination of the nereis noctiluca by Fougeroux de Bondaroy *.

The animal discovered by Riville shed a blue liquor, which illuminated the water for a distance of two or three lines †.

Spallanzani relates, that the medusa which he examined, communicated the property of shining to water, milk, and other fluids, on being rubbed or squeezed in them ‡.

The luminous fluid is in some instances confined to particular parts of the body, and in others is diffused throughout the whole substance of the animal.

In the scolopendra electrica, it appears to reside immediately under the integuments. In the lynceus discovered by Riville, it is contained in the ovary. If I may judge from my own observations, every part of the body of the medusæ is furnished with this fluid, as there is no part I have not seen illuminated under different circumstan-

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* Mem. de l' Acad. des Sc. 1767.

† Mem. Etrang. de l' Acad. des Sc. Tom. iii.

‡ Spallanzani's Travels in the Two Sicilies, Vol. iv.

ces, but Spallanzani affirms that it is only found in the large tentacula, the edges of the umbella, and the purse or central mass; which he proved, he says, by detaching these parts successively, when they shone vividly, while the rest of the body neither gave light or communicated any luminous appearance to water *.

Spallanzani discovered a mucous luminous fluid in the plumule of the pennatula phosphorea †.

The phenomenon of animal light has been attempted to be explained in different ways. By many persons it was formerly ascribed to a putrefactive process, but since the modern theories of combustion became known, it has been generally believed to depend upon an actual inflammation of the luminous substance, similar to the slow combustion of phosphorus. Others have accounted for the luminous effect, by supposing the matter of light to be accumulated, and rendered latent under particular circumstances, and afterwards evolved in a sensible form.

The opinion of the light of living animals being the consequence of putrefaction, is evidently absurd, and contradictory to all observation on the subject. It has been proved by the experiments of Dr. Hulme and others, that even the luminous appearances of dead animals, are exhibited only during the first stages of the dissolution of the body, and that no light is emitted after putrefaction has really commenced.

Spallanzani, who was the most strenuous advocate for the phosphorescent nature of animal light, stated that glow-worms shone more brilliantly when put into oxygen gas;

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* Memoria sopra le meduse fosforiche. Mem. della Soc. Ital. Tomo vii.

† Mem. della Soc. Ital. Tomo ii.

gas; that their light gradually disappeared in hydrogen or in azotic gas, and was instantly extinguished in fixed air; that it was also lost by cold, and revived by the application of a warm temperature. He conjectured that the luminous matter of these insects was composed of hydrogen and carbonated hydrogen gas.

Forster relates, in the Lichtenberg Magazine for 1783, that on putting a lampyris splendidula into oxygen gas, it gave as much light as four of the same species in common air.

Carradori has made some experiments upon the lucciole, (lampyris italica) which led him to deny its phosphorescence. He found that the luminous portion of the belly of the insect shone in vacuum, in oil, in water, and different liquids, and under different circumstances, where it was excluded from all communication with oxygen gas. He accounts for the result of Forster's experiment, by supposing, that the worm shone more vividly, because it was more animated in oxygen gas than in common air.

Carradori adopts on this subject the doctrine of Brugnatelli, and ascribes the luminous appearances of animals, to the condensation and extrication of light in particular organs, which had previously existed in combination with the substance of their bodies. He supposes the light to be originally derived from the food, or the atmospheric air taken into the body; in short, that certain animals have the peculiar property of gradually imbibing light from foreign bodies, and of afterwards secreting it in a sensible form *.

The following experiments which I made upon this subject,

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* Annal. di Chimica, Tomo xiii. 1797.

subject, would lead me to make different conclusions than those of the preceding authors.

Experiment 1.—A glow-worm was put into a glass of water, in which it lived nearly two hours, and continued to emit light as usual, until it died, when the luminous appearance entirely ceased.

Experiment 2.—The luminous substance was extracted from the beforementioned glow-worm, and from others killed in different ways, but it afforded no light.

Experiment 3.—The sacs containing the luminous matter were cut from the bellies of *living* glow-worms, and shone uninterruptedly for several hours in the atmosphere; and after their light became extinct, it was revived by being moistened with water; some of these were put into water in the first instance, in which they continued to shine unremittingly for 48 hours.

Experiment 4.—The luminous substance of a glow-worm was exposed to a degree of heat which would have been sufficient to inflame phosphorus, without increasing the brilliancy of its light; and farther, it could not be made to burn by being applied to a red hot iron, or to the flame of a candle.

Experiment 5.—A delicate thermometer was introduced amongst some living glow-worms, during the time they gave out much light: the temperature of the room being 69, the instrument rose to 75, 76, and 77, according to circumstances, as the warmth was reflected from the hand, or dissipated by the worm crawling over cold substances. The luminous portion of the tail, when very brilliant, appeared to raise the thermomete more quickly than the other parts of the body, but i was not invariably the case. When shining strongly, thought that the luminous rings communicated the sen-

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sation of warmth to the hand, but this was probably a deception, as the actual degree of heat was not sufficient for such an effect. It should however be mentioned, that in Templar's observations on the glow-worm, he said his feelings deceived him, if he did not experience some heat from the shining of the insect *.

Experiment 6.—To satisfy myself how far the evolution of heat during the shining of glow-worms, depended upon the life of the animals, I cut off the luminous portion of the tail from several living worms, and I found that if the thermometer was applied to them immediately, it was raised by them one or two degrees; but after these parts were dead, although they continued to emit light, they produced no effect whatever upon the instrument.

Experiment 7.—Some hemispherical medusæ were put into a spoon, containing a small quantity of sea-water, and held over a burning candle. As soon as the water became heated the medusæ appeared like illuminated wheels, the spots at the margin and centre alone emitting light; in which manner they shone vividly and permanently for about 20 seconds, when they shrunk and died, after which they were no longer luminous.

Experiment 8.—Some of the same species were put into spirits: a strong and unremitting light was instantly given out, which issued from the central and marginal parts, as in the preceding experiment, and continued until they died.

Experiment 9.—Some of the scintillating and hemispherical species of medusa, contained in a small glass jar, were introduced into the receiver of an air-pump, and the air being exhausted, they shone as usual when shaken; if any difference could be perceived, the light was more easily excited, and continued longer in vacuum.

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* Phil. Trans. No. 72.

I wished next to try the influence of electricity on the luminous property of animals.

Experiment 10.—A medusa hemispherica was placed in a small glass dish, containing a quantity of water, merely sufficient to allow the animal to preserve its figure; being insulated, it was electrified, and sparks drawn from it, which had not the slightest effect; the experiment was repeated several times with different individuals, but without exciting the animals to throw out light.

Experiment 11.—Some hemispherical medusæ were placed in contact with the two ends of an interrupted chain, and slight electric shocks passed through them. During the very moment of their receiving the shock no light was visible, but immediately afterwards the medusæ shone like illuminated wheels, which appearance remained for some seconds. Upon the closest inspection with a magnifying glass, no contractile motion could be perceived to accompany the exhibition of the light. The application of electricity in this instance seems to have acted merely as a strong mechanic shock.

The above experiments on the luminous medusæ were made at Herne, with the assistance of George May, Esq. of Stroud-house, and in the presence of a large company, capable of accurately distinguishing their results.

It seems proved by the foregoing experiments, that so far from the luminous substance being of a phosphorescent nature, it sometimes shews the strongest and most constant light, when excluded from oxygen gas; that it in no circumstances undergoes any process like combustion, but is actually incapable of being inflamed; that the increase of heat, during the shining of glow-worms, is an accompaniment, and not an effect of the phenomenon, and depends upon the excited state of the insect; and lastly, that heat and electricity increase the exhibition of light, merely by operating like other stimuli upon the vital properties of the animal.

In confirmation of these opinions, I may quote the high authority of the Secretary of this Society, who has found that the light of the glow-worm is not rendered more brilliant in oxygen, or in oxygenated muriatic gas, than in common air; and that it is not sensibly diminished in hydrogen gas.

I may further add, that Spallanzani's experiments of diffusing the luminous liquor of the medusa in water, milk, and other fluids, are in direct contradiction of his own theory, as is also the extinction of the light of these mixtures by the application of a high degree of heat.

If the light emitted by animals were derived from their food, or the air they respire, as supposed by Carradori, the phenomenon should be increased or diminished, according to the quantity of food or air, that the creatures consume; but we do not find this to be the case; for in those situations where they are sometimes found to be most luminous, they are deprived, in a great measure, of these assumed sources of their light.

In fact, the luminous exhibitions of living animals are not only independent of all foreign light, but are frequently destroyed by the latter. I have always found the shining of the medusæ to cease upon the rising of the moon, or at the approach of day; and when out of the sea, I never could excite them to throw out light until they had been kept for some time in the dark; all the luminous insects likewise secrete themselves as much as possible during the day time, and go abroad only at night. I have, it is true, found that the scolopendra electrica will not shine unless it has been previously exposed to solar light; but I have observed that it shone as brilliantly and as frequently, after being kept a short time in a light situation, as when left uncovered the whole day. The circumstance of the scolopendra requiring exposure previous to its giving out light, is very unaccountable, as the insect, when left to itself, always seeks as much as possible concealment during the day; indeed it is the opinion of some naturalists that it is killed by the light of the sun.

The opinions of Brugnatelli and Carradori are connected with some general doctrines, respecting the nature of light, which I shall not at present venture to discuss. It appears to me, that the question is still unresolved, whether light has a substantial existence, or is a phenomenon depending upon certain operations or conditions of the ordinary forms of matter. But the highly ingenious researches of Count Rumford, on the laws of what have been called subtile fluids, and the extraordinary advances lately made by Mr. Davy, on the decomposition of substances, that were hitherto looked upon as elementary, give us reason to hope, that future investigations may unfold views of the material world, of which we can at present have only an indistinct conception; that new modes of analysis may enable us to see things, not "through a glass darkly," but more nearly as they are; and that the boundaries of physical and metaphysical science, now so far asunder, may be made to approach each other.

In the present state of our knowledge, our business should be, to collect, arrange, and compare phenomena, rather than to speculate upon their nature. Nevertheless, I cannot refrain from observing, that the circumstances attending the luminous appearance of living animals, are much more favourable to the supposition of light being a property, than a substance. The quantity of light emitted by an animal in a certain time, (admitting it to be matter) far exceeds that which could be possibly supplied by the sources, from whence it is usually supposed to be derived. Thus the luminous appearance of some medusæ may be continued with the intermission of short intervals for an indefinite time, notwithstanding the creature be kept in darkness, and without any other food than what a small quantity of filtered sea-water would afford. The uninterrupted and long continued light that is sometimes evolved by the luminous sacs, and the ova of the glow-worm, is also inconsistent with the notion of an accumulation and subsequent dispersion of a material substance.

I shall terminate this paper by an enumeration of the several conclusions, that are the result of the observations I have been able to make upon the phenomena of animal light.

The property of emitting light is confined to animals of the simplest organisation, the greater number of which are inhabitants of the sea.—The luminous property is not constant, but in general, exists only at certain periods, and in particular states of the animal's body.—The power of shewing light, resides in a peculiar substance or fluid, which is sometimes situated in a

par-

particular organ, and at others diffused throughout the animal's body.—The light is differently regulated, when the luminous matter exists in the living body, and when it is extracted from it. In the first case, it is intermitting, or alternated with periods of darkness; is commonly produced or increased by a muscular effort; and is sometimes absolutely dependant upon the will of the animal. In the second case, the luminous appearance is usually permanent until it becomes extinct, after which it may be restored directly by friction, concussion, and the application of warmth; which last causes operate on the luminous matter (while in the living body), only indirectly, by exciting the animal.—The luminous matter, in all situations, so far from possessing phosphoric properties, is incombustible, and loses the quality of emitting light, by being dried, or much heated.—The exhibition of light, however long it may be continued, causes no diminution of the bulk of the luminous matter. It does not require the presence of pure air, and is not extinguished by other gasses.

The luminous appearance of living animals is not exhausted by long continuance, or frequent repetitions, nor accumulated by exposure to natural light; it is therefore, not dependent upon any foreign source, but inheres as a property, in a peculiarly organised animal substance or fluid, and is regulated by the same laws which govern all the other functions of living beings.

The light of the sea is always produced by living animals, and most frequently by the presence of the medusa scintillans. When great numbers of this species approach the surface, they sometimes coalesce together, and cause that snowy or milky appearance of the sea, which is so alarming to navigators. These animals, when en congregated on the surface of the water, can pro- ce a flash of light, somewhat like an electric corus- ion. When the luminous medusæ are very numerous, frequently happens in confined bays, they form a nsiderable portion of the mass of the sea, at which es they render the water heavier, and more nauseous the taste; it is therefore adviseable to always strain sea ter before it is drunk.

The luminous property does not appear to have any nnection with the œconomy of the animals that pos- s it, except in the flying insects, which by that ans discover each other at night, for the purpose of ual congress.

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w Method of applying the Filtering-Stone for purifying Vater. By Mr. William Moult, *of Bedford Square.*

With an Engraving.

om the Transactions of the Society for the Encou- ragement of Arts, Manufactures, and Commerce.

The Silver Medal of the Society was voted for this Communication.

OBJECT to the old method of filtering by putting ter into the filtering-stone, because the dirt falls to e bottom, and fills up, or chokes the pores of the tering-stone, so that the stone requires frequently to cleaned with a brush and sponge to allow the water to ss, after which the water passes through the stone in muddy state for two or three days; it likewise requires be frequently filled, and as it empties less water mes in contact with the stone, and therefore a smaller quantity, in such a state, can only pass through. Likewise a filtering-stone used in the common way soon becomes useless, from the filth insinuating itself into the internal parts of the stone, out of the reach of the brush.

In the method I propose and practise, the filtering-stone is placed within the water to be purified, which presses upon the outside of the filter, and the stone does not require to be supported in a frame as it needs only to stand within the water cistern; it will thus filter, in an equal time, double the quantity of water procured in the common mode; it fills itself and requires no cleaning. I have upon this plan used one for more than three years with great success.

REFERENCE TO THE DRAWING.

A A, Fig. 1, (Plate XVII.) is the cistern containing the water to be filtered; the filtering-stone B is suspended in the cistern by a ring around the inside of it, which catches the projecting part of the stone; the water in the cistern filters through into the stone. D is a syphon which conveys the filtered water from the inside of the stone into a cistern E, which is the reservoir for clean water. *d* a cock to draw it off as it is wanted. By this mode of filtration the impurities of the water are deposited in the bottom of the cistern A, instead of being left in the bottom of the stone as in the usual mode.

Method

ethod of raising a loaded Cart when the Horse in the Shafts has fallen. By Mr. BENJAMIN SMITH, *of Turnham-place, Curtain-road, Shoreditch.*

With an Engraving.

rom the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

ifteen Guineas were voted by the Society for this Communication.

A, Fig. 2, (Plate XVII.) is the wheel, and B the hafts of a cart, such as is used in London; *c* the side-ails; at the end of the body an iron stancheon or truss-taff, *a*, is fixed by a hinge at the lower end, and at he upper end it is supported by a chain *b*, extended rom the fore part of the body of the cart; this diagonal hain forms a firm support to the stancheon. This is all he addition made to the common cart, and is used in he event of the shaft-horse falling, by hooking the races of the other horses to a chain *d*, also fixed to the ancheon; the power of these horses, applied at this eight above the fulcrum, will have a great purchase to levate the shafts and set the fallen horse at liberty, as evident from an inspection of the figure. The stan-heon moves on a joint on its lower end, and the ob-que chain unhooks at *b*; the end can be connected ith a short piece of chain *e* fastened to the last of the ide-rails; the stancheon now takes the position of the otted lines *f*, and the short chain which hangs down perpendicular from the end of it, may be taken hold of by any number of men, to weigh upon and raise the cart in cases where the horses cannot conveniently be applied; the men will in this manner have much greater effect than merely (as is the common practice) weighing on the hind part of the cart.

When the chain is completely detached, and the stancheon suffered to hang down perpendicularly, it forms a prop to support the cart steady whilst it is unloaded. It should be observed, that though only one stancheon appears in the figure, there are in fact two, one being placed on each side of the cart.

Advantages derivable from this Invention.

1.—The invention is of itself so simple, and the operation so conspicuous at the first view, that the whole process may be easily comprehended and executed.

2.—The apparatus may be fitted with little difficulty to any cart now in use for heavy loads, such as bricks, coals, corn, or the like.

3.—The chains which lead from the uprights at the back part of the cart to the fore part of it on each side are for the purpose of taking the purchase therefrom, and making the back part of the cart act as a lever at the time the horses are drawing behind, which without fail, with the strength of one, two or three horses fastened there to raise the one which is down in the shafts, will instantly assist him to get upon his feet.

4.—The number of horses to draw a cart are usually in proportion to the weight contained therein; therefore supposing three horses are employed to draw it, and the shaft horse falls, the carman has only to unhook the two leaders, and then hook them to the short chain at each side of the back of the cart, and with their strength the fallen horse will be so relieved from the weight as to raise himself without further assistance.

5.—The same principle may be applied in different ways from what I have shown in the model; for instance, another mode may be adopted by framing the tail-board of the cart strong enough to bear the purchase, and with the use of the two side chains abovementioned, it may be made to answer the purpose.

Another plan, though more expensive, is by obtaining two wrought-iron uprights to be fixed as substitutes for the truss-staffs at the back part of the cart, with a hole in the top of each to receive an iron rod, which is occasionally to be introduced, reaching from one side of the cart to the other, connecting the two uprights together; when in action the two side chains to be used as in other cases.

Method of Ventilating Mines or Hospitals, by extracting the foul Air from them.

By Mr. JOHN TAYLOR, *of Holwell, near Tavistock.*

With an Engraving.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal of the Society was voted for this Communication.

NEXT in importance to the means employed for draining underground works from water may be reckoned those which are intended to afford a supply of pure air, sufficient to enable the workmen to continue their operations with ease and safety to themselves, and to keep up, undiminished, the artificial light upon which they depend. It is well known, indeed, to all who are practically engaged in concerns of this kind, that men are frequently obliged to persevere in their labour, where a candle will scarcely burn, and where not only their own health materially suffers in the end, but their employers are put to considerable additional expense by the unavoidable hinderance and the waste of candles and other materials.

I mean to confine the following remarks to such mines as are worked upon metalliferous veins, according to the practice of this district, and that of the great seat of mining in the neighbouring county of Cornwall, from which indeed ours is borrowed. We find then that a single shaft, not communicating by levels to another, can hardly be sunk to any considerable depth, nor can a level (or as the foreign miners call it, a gallery) be driven horizontally to any great distance without some contrivance being had recourse to for procuring currents of air to make up the deficiency of oxygen, which is so rapidly consumed by respiration and combustion in situations like these, where otherwise the whole remains in nearly a stagnant condition.

We are here unacquainted with the rapid production of those gasses which occasionally in the collieries are the cause of such dreadful effects; such as hydrogen gas, or the fire-damp, carbonic acid, or the choke-damp; the inconvenience we experience takes place gradually as we recede from the openings to the atmosphere, and seems to arise solely from the causes I have before assigned, though it is found, to come on more rapidly in certain situations than in others.

The most obvious remedy, and that which is most frequently resorted to. is the opening a communication either to some other part of the mine or to the surface itself, and as soon as this is done the ventilation is found to be complete, by the currents which immediately take place, often with considerable force, from the different degrees of temperature in the subterranean and upper atmospheres; and these currents may be observed to change their directions as the temperatures alternate.

The great objection to this mode of curing the evil is, the enormous expense with which it is most commonly attended. In driving a long level, or tunnel, for instance, it may happen to be at a great depth under the surface, and the intervening rock of great hardness; in such a case every shaft which must be sunk upon it for air alone, where not required (as often they might not) to draw up the waste, would cost several hundred pounds; or in sinking a shaft it may be necessary, at an expense not much less, to drive a level to it from some other for this purpose alone.

To avoid this, recourse has been had to dividing the shaft or level into two distinct parts, communicating near the part intended to be ventilated, so that a current may be produced in opposite directions on each side the partition, and this, where room is to be spared for it, is often effectual to a certain extent. It is found however to have its limits at no very great distance, and the current at best is but a feeble one, from the nearly equal states of heat in the air on each side. The only scheme besides these, that I know of, has hitherto been to force down a volume of purer air, through a system of pipes placed for the purpose, and a variety of contrivances have been devised for effecting this; most of them are so old that they may be found described in Agricola's work *De re Metallicâ*. The most common are by bellows worked by hand; by boxes or cylinders of various forms placed on the surface with a large opening against the wind, and a smaller one communicating with the air-pipes by a cylinder and pistern working in it, which when driven by a sufficient force has great power; but the cheapest and most effectual scheme for this purpose, where circumstances will admit of its being applied, is one which I adopted some time since in the tunnel of the Tavistock canal. It is by applying the fall of a stream of water for this purpose, and it has been long known that a blast of considerable strength may be obtained in this manner, which has the advantage of being constant and self-acting. The stream being turned down a perpendicular column of pipes, and dashing in at a vessel so contrived as to let off the water one way, with an opening at another part for the air, which being pressed into it by the falling water, may be conveyed in any direction, and will pass through air-pipes with a strong current. This will be found efficacious in ventilating mines in many instances, as it has likewise, in some cases, been sufficient for urging the intensity of fires for the purposes of the forge. It is easily procured where a sufficient fall is to be had, and the perpendicular column can be so fixed as that the water from the bottom may pass off, while the air is forced into a pipe branching from the air-vessel, and which is to be continued to the part of the mine where the supply of fresh air is required.

I have found, however, that the forcing into vitiated air a mixture of that which is purer, even when the best means are used, though a measure which affords relief, is not in bad cases a complete remedy, and where the operation depends on manual labour, or any means that are not unremitted in their action, it becomes quite ineffectual. The foul air, charged with the smoke of gunpowder used in blasting, and which it strongly retains, is certainly ameliorated by the mixture of pure air, but is not removed. While the blast continues, some of it is driven into the other parts of the mine; but when the influx of pure air ceases it returns again, or if during the influx of pure air a fresh volume of smoke be produced by explosions which are constantly taking place, it is not until some time afterwards that it becomes sufficiently attenuated for the workmen to resume their stations with comfort.

A consideration of these circumstances led me to think that the usual operation of all ventilating engines ought to be reversed, to afford all the advantages that could be desired; that instead of using the machines, which serve as condensers, exhausters should be adopted; and thus, instead of forcing pure air into that in a vitiated state, a complete remedy could only be had by pumping out all that was impure as fast as it became so.

Many modes of doing this suggested themselves to me, by the alteration of the machines commonly applied, and by producing an ascending stream of air through pipes by a furnace constructed for the purpose. The latter mode would however have been here expensive in fuel as well as in attendance, and the others required power to overcome the friction of pistons, and so on, or considerable accuracy in construction.

I at last erected the machine, of which the annexed is a drawing, which, while it is so simple in construction, and requires so small an expense of power, is so complete in its operation, and its parts are so little liable to be injured by wear, that as far as I can imagine, nothing more can be desired where such a one is applied. This engine bears considerable resemblance to Mr. Pepys'

Pepys' gazometer, though this did not occur to me until after it was put to work. It will readily be understood by an inspection of the drawing, where the shaft of the mine is represented at A (see Fig. 3, Plate XVII.); and it may here be observed, that the machine may be as well placed at the bottom of the shaft as at the top, and that in either case it is proper to fix it upon a floor, which may prevent the return of the foul air into the mine, after being discharged from the exhauster; this floor may be furnished with a trap-door, to be opened occasionally for the passage of buckets through it.

B the air-pipe from the mine passing through the bottom of the fixed vessel or cylinder C, which is formed of timber and bound with iron hoops; this is filled with water nearly to the top of the pipe B, on which is fixed a valve opening upwards at D.

E, the air or exhausting-cylinder, made of cast-iron, open at the bottom, and suspended over the air-pipe, immersed some way in the water. It is furnished with a wooden top, in which is an opening fitted with a valve likewise opening upwards at F.

The exhausting-cylinder has its motion up and down given to it by the bob G, connected to any engine by the horizontal rod H, and the weight of the cylinder is balanced, if necessary, by the counterpoise I.

The action is obvious.—When the exhausting cylinder is raised, a vacuum would be produced, or rather the water would likewise be rained in it, were it not for the stream of air from the mine rushing through the pipe and valve D. As soon as the cylinder begins to descend, this valve closes and prevents the return of the air, which is discharged through the valve F.

The quantity of air exhausted is calculated of course from the area of the bore of the cylinder, and the length of the stroke.

The dimensions which I have found sufficient for large works are as follow:

The bore of the exhausting cylinder two feet.

The length six feet, so as to afford a stroke of four feet.

The pipes which conduct the air to such an engine ought not to be less than six-inch bore.

The best rate of working is from two to three strokes a minute; but if required to go much faster it will be proper to adapt a capacious air-vessel to the pipes near the machine, which will equalize the current pressing through them.

Such an engine discharges more than two hundred gallons of air in a minute; and I have found that a stream of water supplied by an inch and a half bore falling twelve feet, is sufficient to keep it regularly working.

A small engine to pump out two gallons at a stroke, which would be sufficient in many cases, could be worked by a power equal to raising a very few pounds weight, as the whole machine may be put into complete equilibrium before it begins to work, and there is hardly any other friction to overcome but that of the air passing through the pipes.

The end of the tunnel of the Tavistock Canal, which it was my object to ventilate, was driven into the hill to a distance of near three hundred yards from any opening to the surface, and being at a depth of one hundred and twenty yards, and all in hard schistus rock, air-shafts would have been attended with an enormous expense;

pense; so that the tunnel being a long one, it was most desirable to sink as few as possible, and of course at considerable distances from each other. Thus a ventilating machine was required, which should act with sufficient force through a length of near half a mile, and on the side of the hill where it first became necessary to apply it, no larger stream of water to give it motion could be relied on, than such a one as I have mentioned after the description of the engine, and even that flowed at a distance from the shaft where the engine was to be fixed, which made a considerable length of connecting-rods necessary.

Within a very short time after the engine began to work, the superiority of its action over those formerly employed was abundantly evident. The whole extent of the tunnel which had been uninterruptedly clouded with smoke for some months before, and which the air that was forced in never could drive out, now became speedily so clear, that the day light and even objects at its mouth were distinctly seen from its farthest end. After blowing up the rock, the miners could instantly return to the place where they were employed, unimpeded by the smoke, of which no appearance would remain underground in a very few minutes, while it might be seen to be discharged in gusts, from the valve at the top of the shaft. The constant current into the pipe, at the same time effectually prevented the accumulation of air unfit for respiration. The influx of air, from the level into the mouth of the pipe, rushes with such force as instantly to extinguish the flame of a large candle; and any substance applied, so as to stop the orifice, is held tight by the outward pressure.

It

Pl. XVII. Vol. XVIII. Second Series.

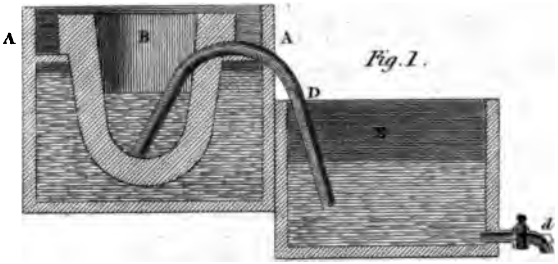


Fig. 1.

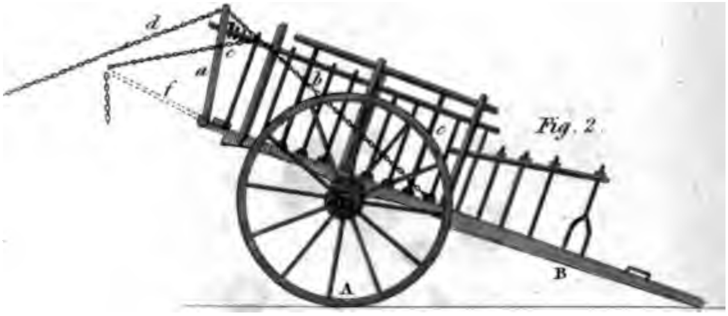
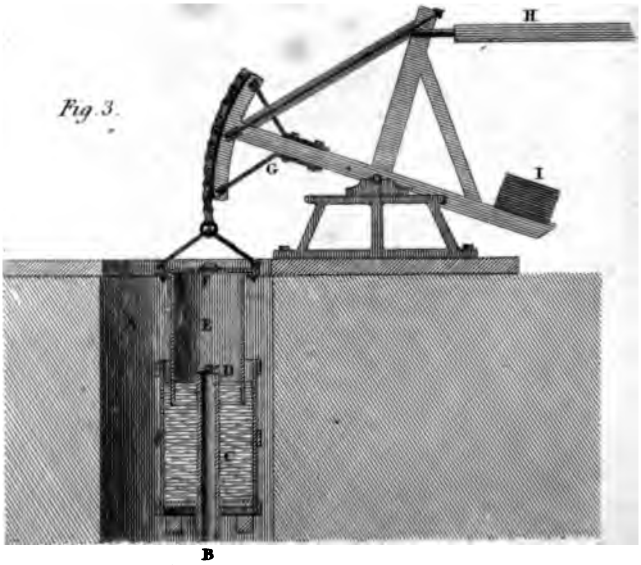


Fig. 2.

Fig. 3.



It is now more than two years since the machine was erected, and it has been uninterruptedly at work ever since, and without repair. The length of the tunnel has been nearly doubled, and the pipes of course in the same proportion, and no want of ventilation is yet perceptible.

Two similar engines have been since constructed for other parts of the same tunnel, and have in every respect answered the purpose for which they were designed.

The original one is worked by the small stream of water before-mentioned, by means of a light overshot-wheel twelve feet in diameter, and about six inches in breast.—The two others are attached to the great overshot-wheel which pumps the water from the shafts which are sinking upon the line, and as their friction is comparatively nothing, this may be done in any case, with so little waste of power for this purpose as not to be an object of consideration, even if the power be derived from more expensive means.

The size of the exhauster may always be proportioned to the demand for air, and by a due consideration of this circumstance, this engine may be effectually adapted not only to mines and collieries, but also to manufactories, work-houses, hospitals, prisons, ships, and so on.

Thus, if it were required to ventilate a shaft of a mine, or a single level, which is most frequently the case, where three men are at work at one time, and we allow that those three men vitiate each twenty-seven and a half cubic inches of air per minute, (as determined by the experiments of Messrs. Allen and Pepys), and allowing further that their candles vitiate as much as the men, there will be six times twenty-seven and a half

List of Patents for Inventions, &c.

(Continued from Page 128.)

James Hume, of Percy-street, St. Pancras, in the county of Middlesex, Esq.; for a sweeping machine or brush, or improvement on a sweeping machine or brush, or sweeping machines or brushes. Dated February 28, 1811.

Robert Salmon, of Woburn, in the county of Bedford, Surveyor; for certain instruments for the relief of hernia, which instrument he calls *Salmon's new Royal Patent Artificial Abdomens*. Dated March 4, 1811.

William Southwell, of Gresse-street, Rathbone-place, in the county of Middlesex, Piano-forte-maker; for certain improvements in the construction of a piano-forte. Dated March 4, 1811.

Edward Savage, of Oxford-street, in the county of Middlesex, Tin-plate-worker; for a machine for washing and bleaching of linen and other articles, and for cooking by means of steam, with a roaster or oven, and warm closets attached, all heated by the same fire. Dated March 4, 1811.

John Trotter, of Soho-square, in the county of Middlesex, Esq.; for improvements in musical instruments. Dated March 4, 1811.

Sarah Guppy, wife of Samuel Guppy, in the city of Bristol, Merchant; for a mode of erecting and constructing bridges and rail roads without arches or sterlings, whereby the danger of being washed away by floods is avoided. Dated March 4, 1811.

WILLIAM TURNER, of 'Change-alley, in the city of
ndon, Merchant; for a pike or halbert, with couteaux.
ated March 4, 1811.

JOHN PLASKETT, of Garlick-hill, in the city of Lon-
n, Stave Merchant, and **SAMUEL BROWN**, of Norfolk-
reet, Southwark, in the county of Surrey, Cooper; for
method of making or manufacturing of casks and other
ssels by improved machinery; which machinery is
plicable to other useful purposes. Dated March 6,
811.

THOMAS WILLIAM STURGEON, of Howland-street, in
e county of Middlesex, Esq.; for improved castors.
ated March 6, 1811.

ABRAHAM WILLIS, of Deritend, in the parish of Aston,
d county of Warwick; for a method of producing
eel toys of different descriptions, such as barbers' curl-
g-irons, sugar-nippers, snuffers, and other articles.
ated March 6, 1811.

RICHARD JACKSON, of the Bear Garden, Southwark,
the county of Surrey, Iron-manufacturer; for a me-
od or methods of making the shanks of anchors and
her large bodies of wrought iron of a similar form, by
sing one solid core of iron for the centre, with bars of
ather-edged iron, so made up, constructed, and ap-
lied, as to save a considerable quantity of iron and
oals and labour in the manufacturing of the same, and
hich will materially add to the strength and soundness
f all large bodies of wrought iron so manufactured.
ated March 7, 1811.

JOHN COLLINGE, of the Bridge-road, Lambeth, in the
ounty of Surrey, Axletree-manufacturer; for an im-
rovement in and upon carriages and other wheel boxes
nd axletrees. Dated March 9, 1811.

James Smethurst, of New Bond-street, in the county of Middlesex, Lamp-manufacturer; for certain improvements applicable to lamps of different descriptions. Dated March 11, 1811.

James Mallory, of the State of New York, one of the United States, now residing in the city of London, Hatter; for a method of making certain machines for cutting and shearing the fur from all pelteries, and for shearing cloth. Communicated to him by certain foreigners residing abroad. Dated March 12, 1811.

Thomas Jones, of Cleveland-street, Fitzroy-square, in the county of Middlesex, Carpenter; for a machine for cutting corks and bungs. Dated March 14, 1811.

Thomas Willis Cooper, of Old-street, in the parish of St. Luke, in the county of Middlesex, Millwright; for certain apparatus to be fixed on the naves of wheels and beds of axletrees of carriages, so as to prevent accidents from the axletrees breaking; or if either of the axletrees should happen to break, the carriage dropping only about a quarter of an inch, the same carriage will proceed on to the end of its journey, without danger of any accident happening from the same; or if by any means the linch-pins get out, or cap-screws get off, the wheels will keep in their former situation. Dated March 14, 1811.

Robert Davis, of Birmingham, in the county of Warwick, Umbrella and Parasol Furniture-manufacturer; for a composition for certain improvements in the manufacturing of all kinds of umbrella and parasol furniture. Dated March 14, 1811.

George Ferguson, of Barbican, in the city of London, Gentleman; for a lamp with its appendages. Dated March 14, 1811.

David Stewart, of Stamford-street, in the parish of Christchurch, in the county of Surrey, Architect; for certain improvements in the method of rendering dwelling-houses, theatres, hospitals, prisons, shippings, conservatories, green-houses, hot-houses, and every other kind of building, air and water-tight, as far as relates to the glazing, by means of a lap made of copper or any other metal or semi-metal prepared by machinery for that purpose. Dated March 22, 1811.

Robert Bill, of Rathbone-place, in the county of Middlesex, Esq.; for a machine or apparatus to facilitate the operation of washing clothes, and other processes necessary in family and other establishments. Dated March 26, 1811.

Robert Wornum the younger, of Princes-street, Hanover-square, in the county of Middlesex, Pianoforte-maker; for an improved upright pianoforte. Dated March 26, 1811.

Joseph C. Dyer, of Boston, State of Massachusetts, one of the United States, but now residing in the city of London, Merchant; for new and improved methods of splitting hides, and shaving or splitting leather. Dated March 26, 1811.

John Craigie, of the city of Bath and county of Somerset, Esq.; for improvements on waggons, carts, and other wheel carriages, whereby friction may be saved, labour facilitated, and a greater degree of safety obtained. Dated March 26, 1811.

Ann Hazledine, of Bridgenorth, in the county of Salop, widow of John Hazledine, of Bridgenorth aforesaid, Engineer, deceased; for certain improvements in a plough for the cultivation of land. Communicated to her by her said husband. Dated March 26, 1811.

JOHN ROSE, of Folkestone, in the county of Kent, a Lieutenant in the Navy, and THOMAS CHAPMAN, of Gough-square, in the city of London, Gentleman; for conveying vessels of any burthen through the water without the assistance of oars or sails. Dated March 26, 1811.

SAMUEL KERROD, of Reading, in the county of Berks, Plasterer; for a cement and size for plastering and stuccoing walls, setting and whitening ceilings, and running and whitening cornices; and colours to be laid on the stucco, as well in oils as distemper; the whole of which are intended for the finishing the inside of houses. Dated March 26, 1811.

JAMES BELL, of Fieldgate-street, Whitechapel, Sugar-refiner; for certain improvements in the manner of cutting, shaving, or scraping sugar loaves and lumps, and of pulverising, or reducing to small grains of powder, sugar loaves, lumps, and bastard sugar. Dated March 26, 1811.

END OF THE EIGHTEENTH VOLUME.—SECOND SERIES

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